

# TGD INSPIRED THEORY OF CONSCIOUSNESS: PART III

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## 0.1 PREFACE

### Brief summary of TGD

Towards the end of the year 2023 I became convinced that it would be appropriate to prepare collections about books related to TGD and its applications. The finiteness of human lifetime was my first motivation. My second motivation was the deep conviction that TGD will mean a revolution of the scientific world view and I must do my best to make it easier.

The first collection would relate to the TGD proper and its applications to physics. Second collection would relate to TGD inspired theory of consciousness and the third collection to TGD based quantum biology. The books in these collections would focus on much more precise topics than the earlier books and would be shorter. This would make it much easier for the reader to understand what TGD is, when the time is finally mature for the TGD to be taken seriously. This particular book belongs to a collection of books about TGD proper.

### The basic ideas of TGD

TGD can be regarded as a unified theory of fundamental interactions but is not the kind of unified theory as so called GUTs constructed by graduate students in the seventies and eighties using detailed recipes for how to reduce everything to group theory. Nowadays this activity has been completely computerized and it probably takes only a few hours to print out the predictions of this kind of unified theory as an article in the desired format. TGD is something different and I am not ashamed to confess that I have devoted the last 45 years of my life to this enterprise and am still unable to write The Rules.

If I remember correctly, I got the basic idea of Topological Geometroynamics (TGD) during autumn 1977, perhaps it was October. What I realized was that the representability of physical space-times as 4-dimensional surfaces of some higher-dimensional space-time obtained by replacing the points of Minkowski space with some very small compact internal space could resolve the conceptual difficulties of general relativity related to the definition of the notion of energy. This belief was too optimistic and only with the advent of what I call zero energy ontology the understanding of the notion of Poincare invariance has become satisfactory. This required also the understanding of the relationship to General Relativity.

It soon became clear that the approach leads to a generalization of the notion of space-time with particles being represented by space-time surfaces with finite size so that TGD could be also seen as a generalization of the string model. Much later it became clear that this generalization is consistent with conformal invariance only if space-time is 4-dimensional and the Minkowski space factor of the embedding space is 4-dimensional. During last year it became clear that 4-D Minkowski space and 4-D complex projective space  $CP_2$  are completely unique in the sense that they allow twistor space with Kähler structure.

It took some time to discover that also the geometrization of also gauge interactions and elementary particle quantum numbers could be possible in this framework: it took two years to find the unique internal space ( $CP_2$ ) providing this geometrization involving also the realization that family replication phenomenon for fermions has a natural topological explanation in TGD framework and that the symmetries of the standard model symmetries are much more profound than pragmatic TOE builders have believed them to be. If TGD is correct, the mainstream particle physics chose the wrong track leading to the recent deep crisis when people decided that quarks and leptons belong to the same multiplet of the gauge group implying instability of the proton.

Instead of trying to describe in detail the path, which led to TGD as it is now with all its side tracks, it is better to summarize the recent view which of course need not be final.

TGD can be said to be a fusion of special and general relativities. The Relativity Principle (Poincare Invariance) of Special Relativity is combined with the General Coordinate Invariance and Equivalence Principle of General Relativity. TGD involves 3 views of physics: physics geometry, physics as number theory and physics as topological physics in some sense.

## Physics as geometry

"Geometro-" in TGD refers to the idea about the geometrization of physics. The geometrization program of Einstein is extended to gauge fields allowing realization in terms of the geometry of surfaces so that Einsteinian space-time as abstract Riemann geometry is replaced with sub-manifold geometry. The basic motivation is the loss of classical conservation laws in General Relativity Theory (GRT)(see **Fig. 23**). Also the interpretation as a generalization of string models by replacing string with 3-D surface is natural.

- Standard model symmetries uniquely fix the choice of 8-D space in which space-time surfaces live to  $H = M^4 \times CP_2$  [L69]. Also the notion of twistor is geometrized in terms of surface geometry and the existence of twistor lift fixes the choice of  $H$  completely so that TGD is unique [L39, L47](see **Fig. 24**). The geometrization applies even to the quantum theory itself and the space of space-time surfaces - "world of classical worlds" (WCW) - becomes the basic object endowed with Kähler geometry (see **Fig. 25**). The mere mathematical existence of WCW geometry requires that it has maximal isometries, which together twistor lift and number theoretic vision fixes it uniquely [L70].
- General Coordinate Invariance (GCI) for space-time surfaces has dramatic implications. A given 3-surface fixes the space-time surface almost completely as analog of Bohr orbit (preferred extremal). This implies holography and leads to zero energy ontology (ZEO) in which quantum states are superpositions of space-time surfaces [K113, L53].
- From the beginning it was clear that the theory predicts the presence of long ranged classical electro-weak and color gauge fields and that these fields necessarily accompany classical electromagnetic fields in all scales. It took about 26 years to gain the maturity to admit the obvious: these fields are classical correlates for long range color and weak interactions assignable to the phases of ordinary matter predicted by the number theoretic vision and behaving like dark matter but identifiable as matter explaining the missing baryon problem whereas the galactic dark matter would correspond to the dark energy assignable monopole flux tubes as deformations of cosmic strings. The only possible conclusion is that TGD physics is a fractal consisting of an entire hierarchy of fractal copies of standard model physics. Also the understanding of electro-weak massivation and screening of weak charges has been a long standing problem and p-adic physics solved this problem in terms of p-adic thermodynamics [K20, K48] [L65].
- One of the most recent discoveries of classical TGD is exact general solution of the field equations. Holography can be realized as a generalized holomorphy realized in terms of what I call Hamilton-Jacobi structure [L67]. Space-time surfaces correspond to holomorphic imbeddings of the space-time surface to  $H$  with a generalized complex structure defined by the vanishing of 2 analytic functions of 4 generalized complex coordinates of  $H$ . These surfaces are automatically minimal surfaces. This is true for any general coordinate invariant action constructed in terms of the induced geometric structures so that the dynamics is universal. Different actions differ only in the sense that singularities at which the minimal surface property fails depend on the action. This affects the scattering amplitudes, which can be constructed in terms of the data related to the singularities [L72].
- Generalized conformal symmetries define an extension of conformal symmetries and one can assign to them Noether charges. Besides this the so called super-symplectic symmetries associated with  $\delta M_+^4 \times CP_2$  define isometries of the "world of classical worlds" (WCW), which by holography is essentially the space of Bohr orbits of 3-surfaces as particles so that quantum TGD is expected to reduce to a generalization of wave mechanics.

## Physics as number theory

During these years TGD led to a rather profound generalization of the space-time concept. Quite general properties of the theory led to the notion of many-sheeted space-time with sheets representing physical subsystems of various sizes. At the beginning of 90s I became dimly aware of the

importance of p-adic number fields and soon ended up with the idea that p-adic thermodynamics for a conformally invariant system allows to understand elementary particle massivation with amazingly few input assumptions. The attempts to understand p-adicity from basic principles led gradually to the vision about physics as a generalized number theory as an approach complementary to the physics as an infinite-dimensional spinor geometry of WCW approach. One of its elements was a generalization of the number concept obtained by fusing real numbers and various p-adic numbers along common rationals. The number theoretic trinity involves besides p-adic number fields also quaternions and octonions and the notion of infinite prime.

Adelic physics [L37, L38] fusing real and various p-adic physics is part of the number theoretic vision, which provides a kind of dual description for the description based on space-time geometry and the geometry of "world of classical words". Adelic physics predicts two fractal length scale hierarchies: p-adic length scale hierarchy and the hierarchy of dark length scales labelled by  $h_{eff} = nh_0$ , where  $n$  is the dimension of extension of rational. The interpretation of the latter hierarchy is as phases of ordinary matter behaving like dark matter. Quantum coherence is possible in arbitrarily long scales. These two hierarchies are closely related. p-Adic primes correspond to ramified primes for a polynomial, whose roots define the extension of rationals: for a given extension this polynomial is not unique.

### $M^8 - H$ duality

The concrete realization of the number theoretic vision is based on  $M^8 - H$  duality (see **Fig. 26**). What the precise form is this duality is, has been far from clear but the recent form is the simplest one and corresponds to the original view [L71].  $M^8$  corresponds to octonions  $O$  but with the number theoretic metric defined by  $Re(o^2)$  rather than the standard norm and giving Minkowskian signature.

The physics in  $M^8$  can be said to be algebraic whereas in  $H$  field equations are partial differential equations. The dark matter hierarchy corresponds to a hierarchy of algebraic extensions of rationals inducing that for adeles and has interpretation as an evolutionary hierarchy (see **Fig. 27**). p-Adic physics is an essential part of number theoretic vision and the space-time surfaces are such that at least their  $M^8$  counterparts exists also in p-adic sense. This requires that the analytic function defining the space-time surfaces are polynomials with rational coefficients.

$M^8 - H$  duality relates two complementary visions about physics (see **Fig. 28**), and can be seen as a generalization of the momentum-position duality of wave mechanics, which fails to generalize to quantum field theories (QFTs).  $M^8 - H$  duality applies to particles which are 3-surfaces instead of point-like particles.

### p-Adic physics

The idea about p-adic physics as physics of cognition and intentionality emerged also rather naturally and implies perhaps the most dramatic generalization of the space-time concept in which most points of p-adic space-time sheets are infinite in real sense and the projection to the real imbedding space consists of discrete set of points. One of the most fascinating outcomes was the observation that the entropy based on p-adic norm can be negative. This observation led to the vision that life can be regarded as something in the intersection of real and p-adic worlds. Negentropic entanglement has interpretation as a correlate for various positively colored aspects of conscious experience and means also the possibility of strongly correlated states stable under state function reduction and different from the conventional bound states and perhaps playing key role in the energy metabolism of living matter.

If one requires consistency of Negentropy Maximization Principle with standard measurement theory, negentropic entanglement defined in terms of number theoretic negentropy is necessarily associated with a density matrix proportional to unit matrix and is maximal and is characterized by the dimension  $n$  of the unit matrix. Negentropy is positive and maximal for a p-adic unique prime dividing  $n$ .

## Hierarchy of Planck constants labelling phases ordinary matter dark matter behaving like dark matter

One of the latest threads in the evolution of ideas is not more than nine years old. Learning about the paper of Laurent Nottale about the possibility to identify planetary orbits as Bohr orbits with a gigantic value of gravitational Planck constant made once again possible to see the obvious. Dynamical quantized Planck constant is strongly suggested by quantum classical correspondence and the fact that space-time sheets identifiable as quantum coherence regions can have arbitrarily large sizes. Second motivation for the hierarchy of Planck constants comes from bio-electromagnetism suggesting that in living systems Planck constant could have large values making macroscopic quantum coherence possible. The interpretation of dark matter as a hierarchy of phases of ordinary matter characterized by the value of Planck constant is very natural.

During summer 2010 several new insights about the mathematical structure and interpretation of TGD emerged. One of these insights was the realization that the postulated hierarchy of Planck constants might follow from the basic structure of quantum TGD. The point is that due to the extreme non-linearity of the classical action principle the correspondence between canonical momentum densities and time derivatives of the imbedding space coordinates is one-to-many and the natural description of the situation is in terms of local singular covering spaces of the imbedding space. One could speak about effective value of Planck constant  $h_{eff} = n \times h$  coming as a multiple of minimal value of Planck constant. Quite recently it became clear that the non-determinism of Kähler action is indeed the fundamental justification for the hierarchy: the integer  $n$  can be also interpreted as the integer characterizing the dimension of unit matrix characterizing negentropic entanglement made possible by the many-sheeted character of the space-time surface.

Due to conformal invariance acting as gauge symmetry the  $n$  degenerate space-time sheets must be replaced with conformal equivalence classes of space-time sheets and conformal transformations correspond to quantum critical deformations leaving the ends of space-time surfaces invariant. Conformal invariance would be broken: only the sub-algebra for which conformal weights are divisible by  $n$  act as gauge symmetries. Thus deep connections between conformal invariance related to quantum criticality, hierarchy of Planck constants, negentropic entanglement, effective p-adic topology, and non-determinism of Kähler action perhaps reflecting p-adic non-determinism emerges.

The implications of the hierarchy of Planck constants are extremely far reaching so that the significance of the reduction of this hierarchy to the basic mathematical structure distinguishing between TGD and competing theories cannot be under-estimated.

## TGD as an analog of topological QFT

Consider next the attribute "Topological". In condensed matter physical topological physics has become a standard topic. Typically one has fields having values in compact spaces, which are topologically non-trivial. In the TGD framework space-time topology itself is non-trivial as also the topology of  $H = M^4 \times CP_2$ . Since induced metric is involved with TGD, it is too much to say that TGD is topological QFT but one can for instance say, that space-time surfaces as preferred extremals define representatives for 4-D homological equivalence classes.

The space-time as 4-surface  $X^4 \subset H$  has a non-trivial topology in all scales and this together with the notion of many-sheeted space-time brings in something completely new. Topologically trivial Einsteinian space-time emerges only at the QFT limit in which all information about topology is lost (see **Fig. 29**).

Any GCI action satisfying holography=holomorphy principle has the same universal basic extremals:  $CP_2$  type extremals serving basic building bricks of elementary particles, cosmic strings and their thickenings to flux tubes defining a fractal hierarchy of structure extending from  $CP_2$  scale to cosmic scales, and massless extremals (MEs) define space-time correlates for massless particles. World as a set or particles is replaced with a network having particles as nodes and flux tubes as bonds between them serving as correlates of quantum entanglement.

"Topological" could refer also to p-adic number fields obeying p-adic local topology differing radically from the real topology (see **Fig. 30**).

## Zero energy ontology

TGD inspired theory of consciousness entered the scheme after 1995 as I started to write a book about consciousness. Gradually it became difficult to say where physics ends and consciousness theory begins since consciousness theory could be seen as a generalization of quantum measurement theory by identifying quantum jump as a moment of consciousness and by replacing the observer with the notion of self identified as a system which is conscious as long as it can avoid entanglement with environment. The somewhat cryptic statement “Everything is conscious and consciousness can be only lost” summarizes the basic philosophy neatly.

General coordinate invariance leads to the identification of space-time surfaces are analogous to Bohr orbits inside causal diamond (CD). CD obtained as intersection of future and past directed light-cones (with  $CP_2$  factor included). By the already described hologamphy, 3-dimensional data replaces the boundary conditions at single 3-surface involving also normal derivatives with conditions involving no derivatives.

In zero energy ontology (ZEO), the superpositions of space-time surfaces inside causal diamond (CD) having their ends at the opposite light-like boundaries of CD, define quantum states. CDs form a scale hierarchy (see **Fig. 31** and **Fig. 32**). Quantum states are modes of WCW spinor fields, essentially wave functions in the space WCW consisting of Bohr orbit-like 4-surfaces.

Quantum jumps occur between these and the basic problem of standard quantum measurement theory disappears. Ordinary state function reductions (SFRs) correspond to “big” SFRs (BSFRs) in which the arrow of time changes (see **Fig. 33**). This has profound thermodynamic implications and the question about the scale in which the transition from classical to quantum takes place becomes obsolete. BSFRs can occur in all scales but from the point of view of an observer with an opposite arrow of time they look like smooth time evolutions.

In “small” SFRs (SSFRs) as counterparts of “weak measurements” the arrow of time does not change and the passive boundary of CD and states at it remain unchanged (Zeno effect).

## Equivalence Principle in TGD framework

There have been also longstanding problems related to the relationship between inertial mass and gravitational mass, whose identification has been far from obvious.

- Gravitational energy is well-defined in cosmological models but is not conserved. Hence the conservation of the inertial energy does not seem to be consistent with the Equivalence Principle. In this framework the quantum numbers are assigned with zero energy states located at the boundaries of CDs defined as intersections of future and past directed light-cones. The notion of energy-momentum becomes length scale dependent since one has a scale hierarchy for causal diamonds. This allows to understand the non-conservation of energy as apparent.

Equivalence Principle in the form expressed by Einstein’s equations follows from Poincare invariance once it is realized that GRT space-time is obtained from the many-sheeted space-time of TGD by lumping together the space-time sheets to a region of Minkowski space and endowing it with an effective metric given as a sum of Minkowski metric and deviations of the metrics of space-time sheets from Minkowski metric. Similar description relates classical gauge potentials identified as components of induced spinor connection to Yang-Mills gauge potentials in GRT space-time. Various topological inhomogenities below resolution scale identified as particles are described using energy momentum tensor and gauge currents.

At quantum level, the Equivalence Principle has a surprisingly strong content. In linear Minkowski coordinates, space-time projection of the  $M^4$  spinor connection representing gravitational gauge potentials the coupling to induced spinor fields vanishes. Also the modified Dirac action for the solutions of the modified Dirac equation seems to vanish identically and in TGD perturbative approach separating interaction terms is not possible.

The modified Dirac equation however fails at the singularities of the minimal surface representing space-time surface and Dirac action reduces to an integral over singularities for the trace of the second fundamental form slashed between the induced spinor field and its conjugate. Also the  $M^4$  part of the trace is non-vanishing and gives rise to the gravitational coupling. The trace gives both standard model vertices and graviton emission vertices. One

could say that at the quantum level gravitational and gauge interactions are eliminated everywhere except at the singularities identifiable as defects of the ordinary smooth structure. The exotic smooth structures [L62], possible only in dimension 4, are ordinary smooth structures apart from these defects serving as vertex representing a creation of a fermion-antifermion pair in the induced gauge potentials. The vertex is universal and essentially the trace of the second fundamental form as an analog of the Higgs field and the gravitational constant is proportional to the square of  $CP_2$  radius.

- There is a delicate difference between inertial and gravitational masses. One can assume that the modes of the imbedding space spinor fields are solutions of massless Dirac equation in either  $M^4 \times CP_2$  and therefore eigenstates of inertial momentum or in  $CD = cd \times CP_2$ : in this case they are only mass eigenstates. The mass spectra are identical for these options. Inertial momenta correspond naturally to the Poincare charges in the space of CDs. For the CD option the spinor modes correspond to mass squared eigenstates for which the mode for  $H^3$  with a given value of light-proper time is a unitary irreducible  $SO(1,3)$  representation rather than a representation of translation group. These two eigenmode basis correspond to gravitational basis for spinor modes.

## Quantum TGD as a generalization of Einstein's geometrization program

I started the serious attempts to construct quantum TGD after my thesis around 1982. The original optimistic hope was that path integral formalism or canonical quantization might be enough to construct the quantum theory but it turned that this approach fails due to the extreme non-linearity of the theory.

It took some years to discover that the only working approach is based on the generalization of Einstein's program. Quantum physics involves the geometrization of the infinite-dimensional "world of classical worlds" (WCW) identified as the space of 3-dimensional surfaces. Later 3-surfaces were replaced with 4-surfaces satisfying holography and therefore as analogs of Bohr orbits.

- If one assumes Bohr orbitology, then strong correlations between the 3-surfaces at the ends of CD follow and mean holography. It is natural to identify the quantum states of the Universe (and sub-Universes) as modes of a formally classical spinor field in WCW. WCW gamma matrices are expressible in terms of oscillator operators of free second quantized spinor fields of  $H$ . The induced spinor fields identified projections of  $H$  spinor fields to the space-time surfaces satisfy modified Dirac equation for the modified Dirac equation. Only quantum jump remains the genuinely quantal aspect of quantum physics.
- Quantum TGD can be seen as a theory for free spinor fields in WCW having maximal isometries and the generalization of the Super Virasoro conditions gives rise to the analog massless Dirac equation at the level of WCW.

## The world of classical worlds and its symmetries

The notion of "World of Classical Worlds" (WCW) emerged around 1985 but found its basic form around 1990. Holography forced by the realization of General Coordinate Invariance forced/allowed to give up the attempts to make sense of the path integral.

A more concrete way to express this view is that WCW does not consist of 3-surfaces as particle-like entities but almost deterministic Bohr orbits assignable to them as preferred extremals of Kähler action so that quantum TGD becomes wave mechanics in WCW combined with Bohr orbitology. This view has profound implications, which can be formulated in terms of zero energy ontology (ZEO), solving among other things the basic paradox of quantum measurement theory. ZEO forms also the backbone of TGD inspired theory of consciousness and quantum biology.

WCW geometry exists only if it has maximal isometries: this statement is a generalization of the discovery of Freed for loop space geometries [A7]. I have proposed [K42, K22, K110, K81, L70] that WCW could be regarded as a union of generalized symmetric spaces labelled by zero modes which do not contribute to the metric. The induced Kähler field is invariant under symplectic transformations of  $CP_2$  and would therefore define zero mode degrees of freedom if one assumes



that WCW metric has symplectic transformations as isometries. In particular, Kähler magnetic fluxes would define zero modes and are quantized closed 2-surfaces. The induced metric appearing in Kähler action is however not zero mode degree of freedom. If the action contains volume term, the assumption about union of symmetric spaces is not well-motivated.

Symplectic transformations are not the only candidates for the isometries of WCW. The basic picture about what these maximal isometries could be, is partially inspired by string models.

- A weaker proposal is that the symplectomorphisms of  $H$  define only symplectomorphisms of WCW. Extended conformal symmetries define also a candidate for isometry group. Remarkably, light-like boundary has an infinite-dimensional group of isometries which are in 1-1 correspondence with conformal symmetries of  $S^2 \subset S^2 \times R_+ = \delta M_+^4$ .
- Extended Kac Moody symmetries induced by isometries of  $\delta M_+^4$  are also natural candidates for isometries. The motivation for the proposal comes from physical intuition deriving from string models. Note they do not include Poincare symmetries, which act naturally as isometries in the moduli space of causal diamonds (CDs) forming the "spine" of WCW.
- The light-like orbits of partonic 2-surfaces might allow separate symmetry algebras. One must however notice that there is exchange of charges between interior degrees of freedom and partonic 2-surfaces. The essential point is that one can assign to these surface conserved charges when the dual light-like coordinate defines time coordinate. This picture also assumes a slicing of space-time surface by the partonic orbits for which partonic orbits associated with wormhole throats and boundaries of the space-time surface would be special. This slicing would correspond to Hamilton-Jacobi structure.
- Fractal hierarchy of symmetry algebras with conformal weights, which are non-negative integer multiples of fundamental conformal weights, is essential and distinguishes TGD from string models. Gauge conditions are true only the isomorphic subalgebra and its commutator with the entire algebra and the maximal gauge symmetry to a dynamical symmetry with generators having conformal weights below maximal value. This view also conforms with p-adic mass calculations.
- The realization of the symmetries for 3-surfaces at the boundaries of CD and for light-like orbits of partonic 2-surfaces is known. The problem is how to extend the symmetries to the interior of the space-time surface. It is natural to expect that the symmetries at partonic orbits and light-cone boundary extend to the same symmetries.

After the developments towards the end of 2023, it seems that the extension of conformal and Kac-Moody symmetries of string models to the TGD framework is understood. What about symplectic symmetries, which were originally proposed as isometries of WCW? In this article this question is discussed in detail and it will be found that these symmetries act naturally on 3-D holographic data and one can identify conserved charges. By holography this is in principle enough and might imply that the actions of holomorphic and symplectic symmetry algebras are dual. Holography=holomorphy hypothesis is discussed also in the case of the modified Dirac equation.

### About the construction of scattering amplitudes

From the point of view of particle physics the ultimate goal is of course a practical construction recipe for the S-matrix of the theory. I have myself regarded this dream as quite too ambitious taking into account how far-reaching re-structuring and generalization of the basic mathematical structure of quantum physics is required. After having made several guesses for what the counterpart of S-matrix could be, it became clear that the dream about explicit formulas is unrealistic before one has understood what happens in quantum jump.

- In ZEO [K113, L53] one must distinguish between "small" state function reductions (SSFRs) and "big" SFRs (BSFRs). BSFR is the TGD counterpart of the ordinary SFRs and the arrow of the geometric time changes in it. SSFR follows the counterpart of a unitary time evolution and the arrow of the geometric time is preserved in SSFR. The sequence of SSFRs

is the TGD counterpart for the sequence of repeated quantum measurements of the same observables in which nothing happens to the state. In TGD something happens in SSFRs and this gives rise to the flow of consciousness. When the set of the observables measured in SSFR does not commute with the previous set of measured observables, BSFR occurs.

The evolution by SSFRs means that also the causal diamond changes. At quantum level one has a wave function in the finite-dimensional moduli space of CDs which can be said to form a spine of WCW [L68]. CDs form a scale hierarchy. SSFRs are preceded by a dispersion in the moduli space of CDs and SSFR means localization in this space.

- There are several S-matrix like entities. One can assign an analog of the S-matrix to each analog of unitary time evolution preceding a given SSFR. One can also assign an analog S-matrix between the eigenstate basis of the previous set of observables and the eigenstate basis of new observers: this S-matrix characterizes BSFR. One can also assign to zero energy states an S-matrix like entity between the states assignable to the two boundaries of CD. These S-matrix like objects can be interpreted as a complex square root of the density matrix representable as a diagonal and positive square root of density matrix and unitary S-matrix so that quantum theory in ZEO can be said to define a square root of thermodynamics at least formally.

In standard QFTs Feynman diagrams provide the description of scattering amplitudes. The beauty of Feynman diagrams is that they realize unitarity automatically via the so-called Cutkosky rules. In contrast to Feynman's original beliefs, Feynman diagrams and virtual particles are taken only as a convenient mathematical tool in quantum field theories. The QFT approach is however plagued by UV and IR divergences and one must keep mind open for the possibility that a genuine progress might mean opening of the black box of the virtual particle.

In the TGD framework this generalization of Feynman diagrams indeed emerges unavoidably.

- The counterparts of elementary particles can be identified as closed monopole flux tubes connecting two parallel Minkowskian space-time sheets and have effective ends which are Euclidean wormhole contacts. The 3-D light-like boundaries of wormhole contacts as orbits of partonic 2-surfaces.

The intuitive picture is that the 3-D light-like partonic orbits replace the lines of Feynman diagrams and vertices are replaced by 2-D partonic 2-surfaces. A stronger condition is that fermion number is carried by light-like fermion lines at the partonic orbits, which can be identified as boundaries string world sheets.

- The localization of the nodes of induced spinor fields to 2-D string world sheets (and possibly also to partonic 2-surfaces) implies a stringy formulation of the theory analogous to stringy variant of twistor formalism with string world sheets having interpretation as 2-braids. In the TGD framework, the fermionic variant of twistor Grassmann formalism combined with the number theoretic vision [L59, L60] led to a stringy variant of the twistor diagrammatics.
- Fundamental fermions are off-mass-shell in the sense that their momentum components are real algebraic integers in an extension of rationals associated with the space-time surfaces inside CD with a momentum unit determined by the CD size scale. Galois confinement states that the momentum components are integer valued for the physical states.
- The twistorial approach suggests also the generalization of the Yangian symmetry to infinite-dimensional super-conformal algebras, which would determine the vertices and scattering amplitudes in terms of poly-local symmetries.

The twistorial approach is however extremely abstract and lacks a concrete physical interpretation. The holography=holomorphy vision led to a breakthrough in the construction of the scattering amplitudes by solving the problem of identifying interaction vertices [L72].

1. The basic prediction is that space-time surfaces as analogs of Bohr orbits are holomorphic in a generalized sense and are therefore minimal surfaces. The minimal surface property fails at lower-dimensional singularities and the trace of the second fundamental form (SFF) analogous to acceleration associated with the Bohr orbit of the particle as 3-surface has a delta function like singularity but vanishes elsewhere.

2. The minimal surface property expresses masslessness for both fields and particles as 3-surfaces. At singularities masslessness property fails and singularities can be said to serve as sources which also in QFT define scattering amplitudes.
3. The singularities are analogs of poles and cuts for the 4-D generalization of the ordinary holomorphic functions. Also for the ordinary holomorphic functions the Laplace equation as analog massless field equation and expressing analyticity fails. Complex analysis generalizes to dimension 4.
4. The conditions at the singularity give a generalization of Newton's "F=ma"! I ended up where I started more than 50 years ago!
5. In dimension 4, and only there, there is an infinite number of exotic diff structures [?], which differ from ordinary ones at singularities of measure zero analogous to defects. These defects correspond naturally to the singularities of minimal surfaces. One can say that for the exotic diff structure there is no singularity.
6. Group theoretically the trace of the SFF can be regarded as a generalization of the Higgs field, which is non-vanishing only at the vertices and this is enough. Singularities take the role of generalized particle vertices and determine the scattering amplitudes. The second fundamental form contracted with the embedding space gamma matrices and slashed between the second quantized induced spinor field and its conjugate gives the universal vertex involving only fermions (bosons are bound states of fermions in TGD). It contains both gauge and gravitational contributions to the scattering amplitudes and there is a complete symmetry between gravitational and gauge interactions. Gravitational couplings come out correctly as the radius squared of  $CP_2$  as also in the classical picture.
7. The study of the modified Dirac equation leads to the conclusion that vertices as singularities and defects contain the standard electroweak gauge contribution coming from the induced spinor connection and a contribution from the  $M^4$  spinor connection.  $M^4$  part of the generalized Higgs can give rise to a graviton as an  $L = 1$  rotational state of the flux tube representing the graviton. It is not clear whether  $M^4$  Kähler gauge potential can give rise to a spin 1 particle. The vielbein part of  $M^4$  spinor connection is pure gauge and could give rise to gravitational topological field theory.

## Figures

### Basic ideas of TGD inspired quantum biology

The following list gives the basic elements of TGD inspired quantum biology.

- Many-sheeted space-time allows the interpretation of the structures of macroscopic world around us in terms of space-time topology. Magnetic/body acts as intentional agent using biological body as a sensory receptor and motor instrument and controlling biological body and inheriting its hierarchical fractal structure. Fractal hierarchy of EEGs and its variants can be seen as communication and control tools of magnetic body. Also collective levels of consciousness have a natural interpretation in terms of magnetic body. Magnetic body makes also possible entanglement in macroscopic length scales. The braiding of magnetic flux tubes makes possible topological quantum computations and provides a universal mechanism of memory. One can also understand the real function of various information molecules and corresponding receptors by interpreting the receptors as addresses in quantum computer memory and information molecules as ends of flux tubes which attach to these receptors to form a connection in quantum web.

Note that also the notion of electric body makes sense [L66]. Quite generally, long range classical gravitational, electric and magnetic fields give rise to very large values of effective Planck constants. The Nottale's hypothesis of gravitational Planck constant generalizes to electric interactions.

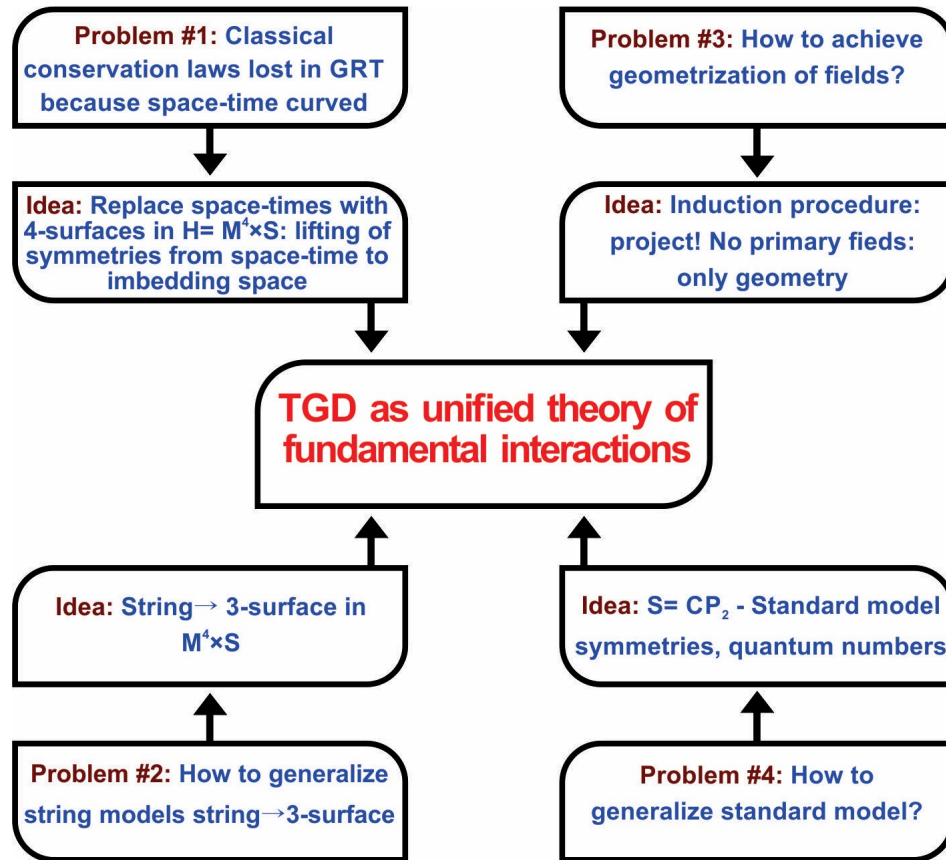


Figure 1: The problems leading to TGD as their solution.

- Magnetic body carrying dark matter and forming an onion-like structure with layers characterized by large values of Planck constant is the key concept of TGD inspired view about Quantum Mind to biology.. Magnetic body is identified as intentional agent using biological body as sensory receptor and motor instrument. EEG and its fractal variants are identified as a communication and control tool of the magnetic body and a fractal hierarchy of analogs of EEG is predicted. Living system is identified as a kind of Indra's net with biomolecules representing the nodes of the net and magnetic flux tubes connections between them.

The reconnection of magnetic flux tubes and phase transitions changing Planck constant and therefore the lengths of the magnetic flux tubes are identified as basic mechanisms behind DNA replication and analogous processes and also behind the phase transitions associated with the gel phase in cell interior. The braiding of magnetic flux makes possible universal memory representation recording the motions of the basic units connected by flux tubes. Braiding also defines topological quantum computer programs updated continually by the flows of the basic units. The model of DNA as topological quantum computer is discussed as an application. In zero energy ontology the braiding actually generalize to 2-braiding for string world sheets in 4-D space-time and brings in new elements.

- Zero energy ontology (ZEO) makes possible the proposed p-adic description of intentions and cognitions and their transformations to action. Time mirror mechanism based on sending of negative energy signal to geometric past would apply to both long term memory recall, remote metabolism, and realization of intentional acting as an activity beginning in the geometric past in accordance with the findings of Libet. ZEO gives a precise content to the notion of negative energy signal in terms of zero energy state for which the arrow of geometric time is opposite to the standard one.

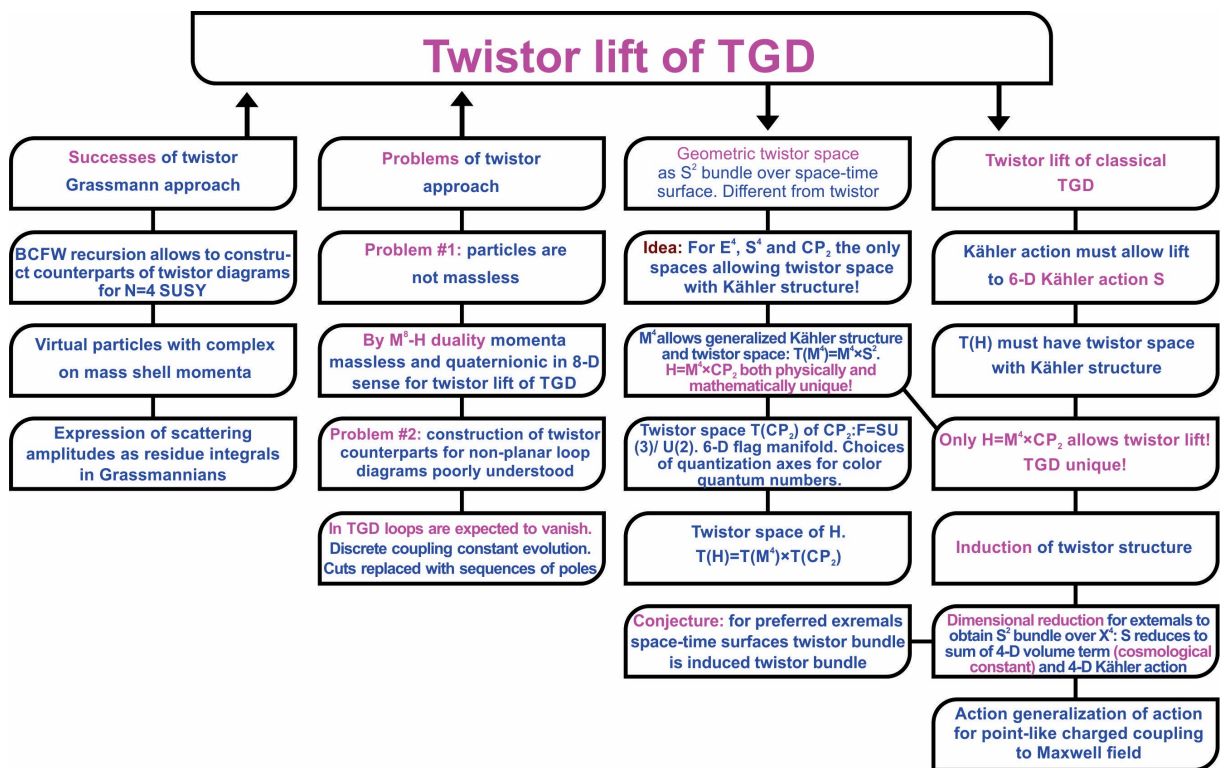
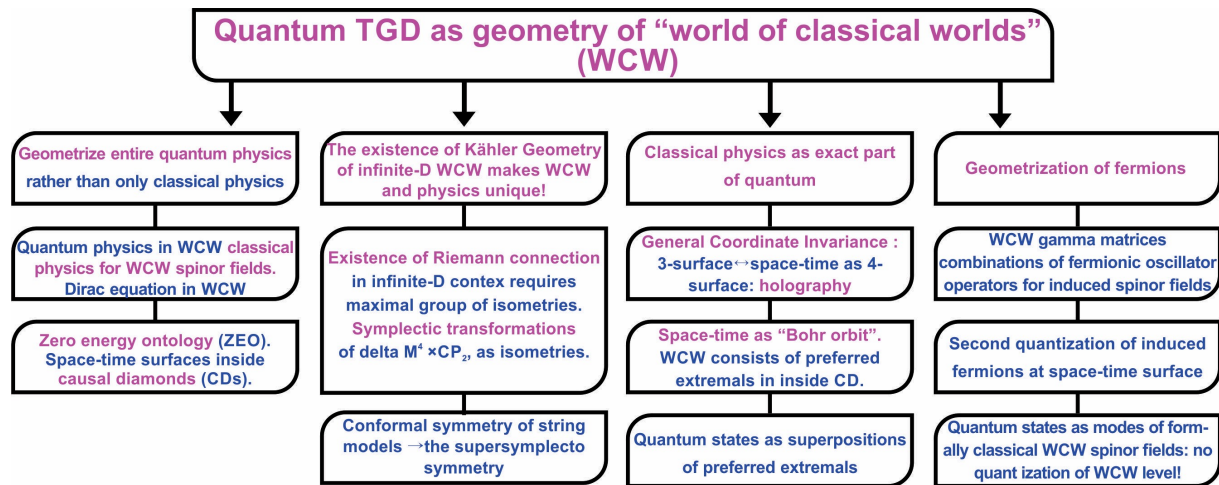


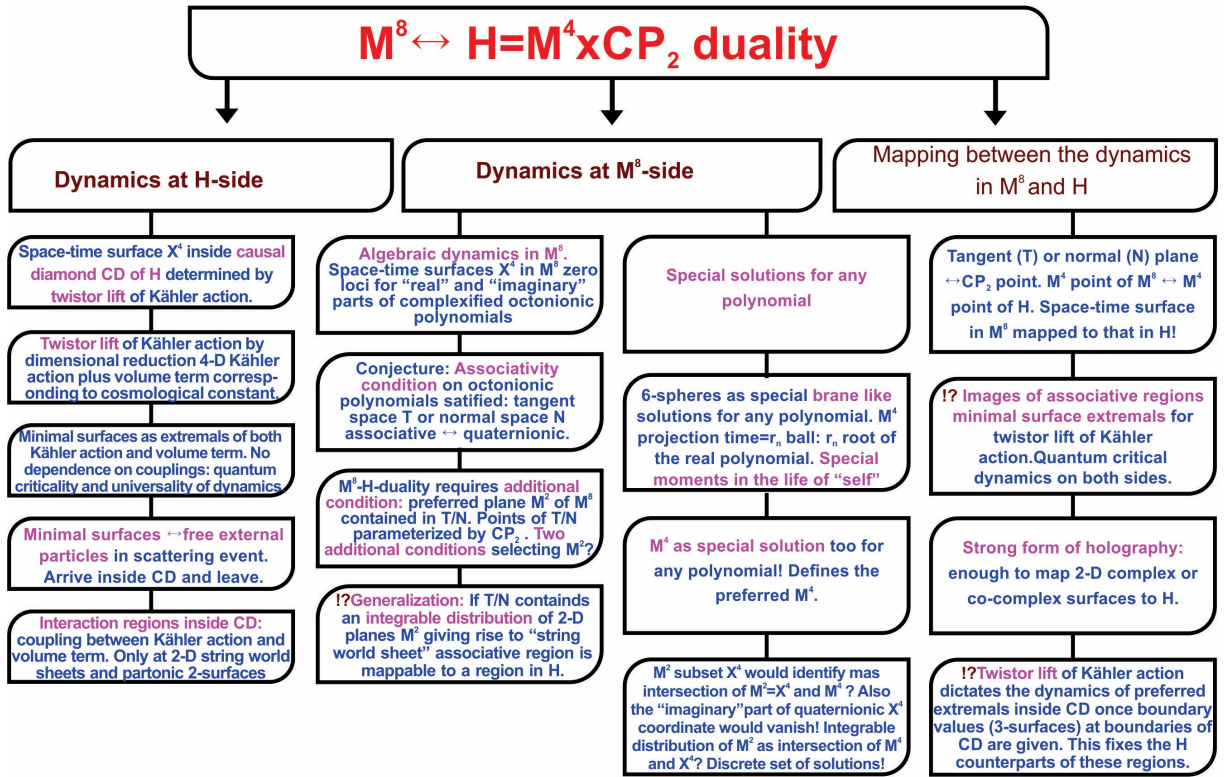
Figure 2: Twistor lift



**Figure 3:** Geometrization of quantum physics in terms of WCW

The associated notion of causal diamond ( $CD$ ) is essential element and assigns to elementary particles new fundamental time scales which are macroscopic: for electron the time scale is .1 seconds, the fundamental biorhythm. An essentially new element is time-like entanglement which allows to understand among other things the quantum counterparts of Boolean functions in terms of time-like entanglement in fermionic degrees of freedom.

- The assignment of dark matter with a hierarchy of Planck constants gives rise to a hierarchy of macroscopic quantum phases making possible macroscopic and macrotemporal quantum coherence and allowing to understand evolution as a gradual increase of Planck constant. The model for dark nucleons leads to a surprising conclusion: the states of nucleons correspond to DNA, RNA, tRNA, and amino-acids in a natural manner and vertebrate genetic code as correspondence between DNA and amino-acids emerges naturally. This suggests that genetic code is realized at the level of dark hadron physics and living matter in the usual sense provides a secondary representation for it. The hierarchy of Planck constants emerges from basic TGD under rather general assumptions.
- p-Adic physics can be identified as physics of cognition and intentionality. Negentropic entanglement possible for number theoretic entanglement entropy makes sense for rational (and even algebraic) entanglement and leads to the identification of life as something residing in the intersection of real and p-adic worlds. NMP respects negentropic entanglement and the attractive idea is that the experience of understanding and positively colored emotions relate to negentropic entanglement.
- Living matter as conscious hologram is one of the basic ideas of TGD inspired biology and consciousness theory. The basic objection against TGD is that the interference of classical

Figure 4:  $M^8 - H$  duality

fields is impossible in the standard sense for the reason that that classical fields are not primary dynamical variables in TGD Universe. The resolution is based on the observation that only the interference of the effects caused by these fields can be observed experimentally and that many-sheeted space-time allows to realized the summation of effects in terms of multiple topological condensations of particles to several parallel space-time sheets. One concrete implication is fractality of qualia. Qualia appear in very wide range of scales: our qualia could in fact be those of magnetic body. The proposed mechanism for the generation of qualia realizes the fractality idea.

Various anomalies of living matter have been in vital role in the development of not only TGD view about living matter but also TGD itself.

- TGD approach to living matter was strongly motivated by the findings about the strange behavior of cell membrane and of cellular water, and gel behavior of cytoplasm. Also the findings about effects of ELF em fields on vertebrate brain were decisive and led to the proposal of the hierarchy of Planck constants found later to emerge naturally from the non-determinism of Kähler action. Rather satisfactorily, the other manner to introduce the hierarchy of Planck constants is in terms of gravitational Planck constant: at least in microscopic scales the equivalence of these approaches makes sense and leads to highly non-trivial predictions. The basic testable prediction is that dark photons have cyclotron frequencies inversely proportional to their masses but universal energy spectrum in visible and UV range which corresponds to the transition energies for biomolecules so that they are ideal for biocontrol at the level of both magnetic bodies and at the level of biochemistry.
- Water is in key role in living matter and also in TGD inspired view about living matter. The

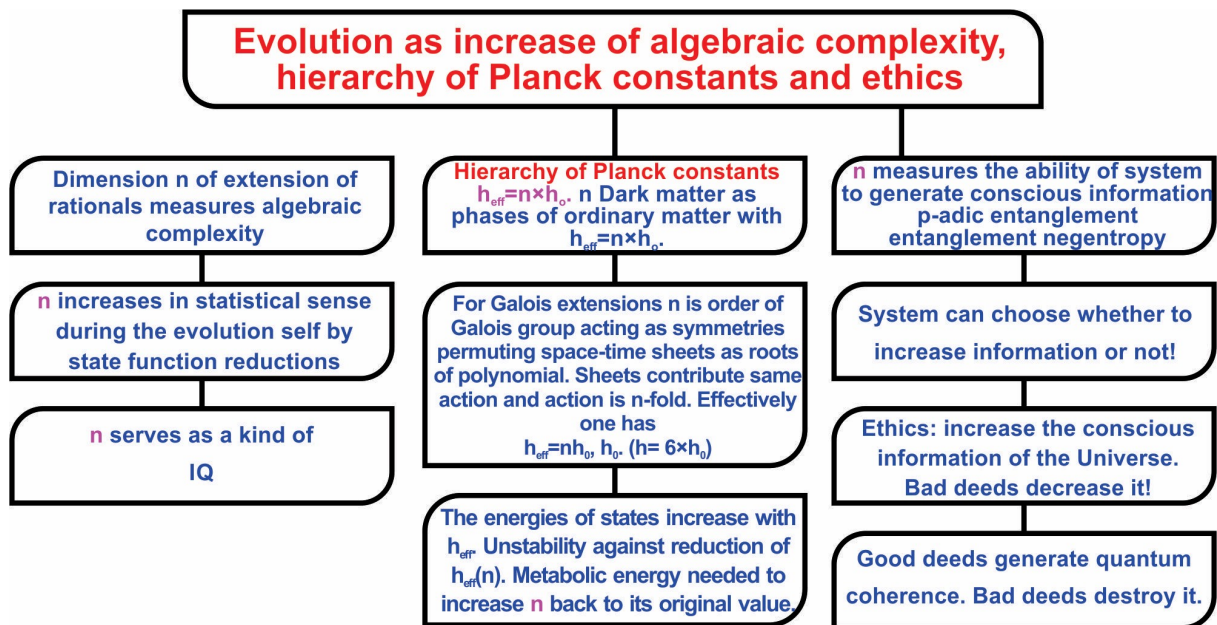
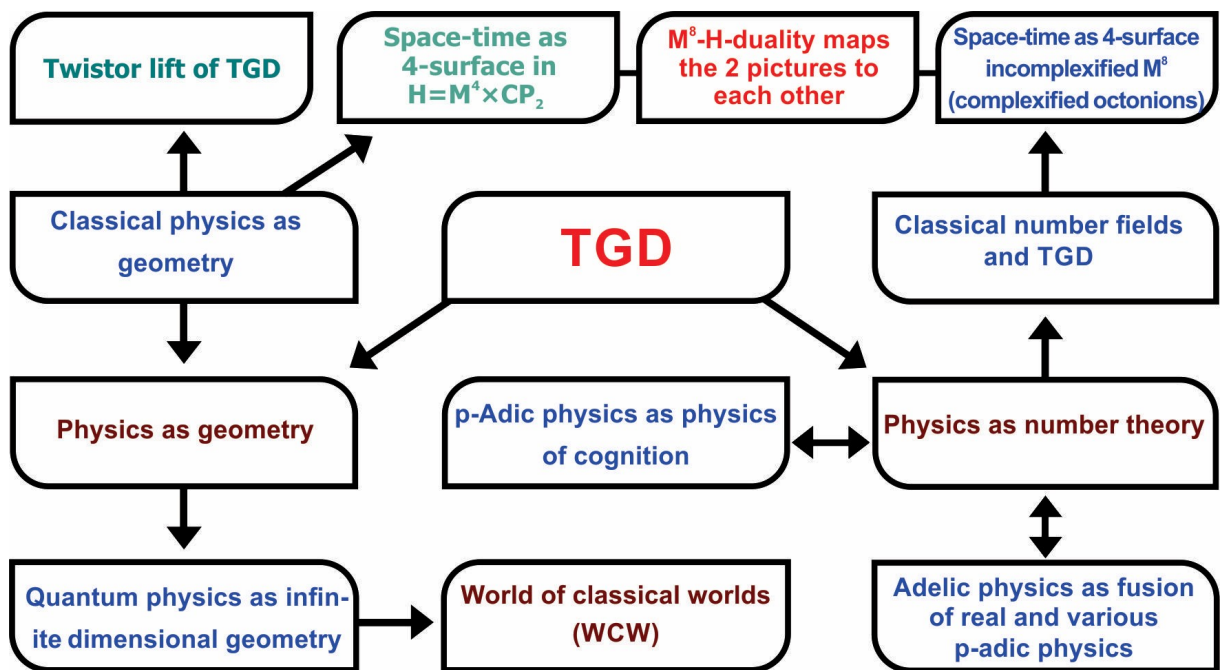


Figure 5: Number theoretic view of evolution





**Figure 6:** TGD is based on two complementary visions: physics as geometry and physics as number theory.

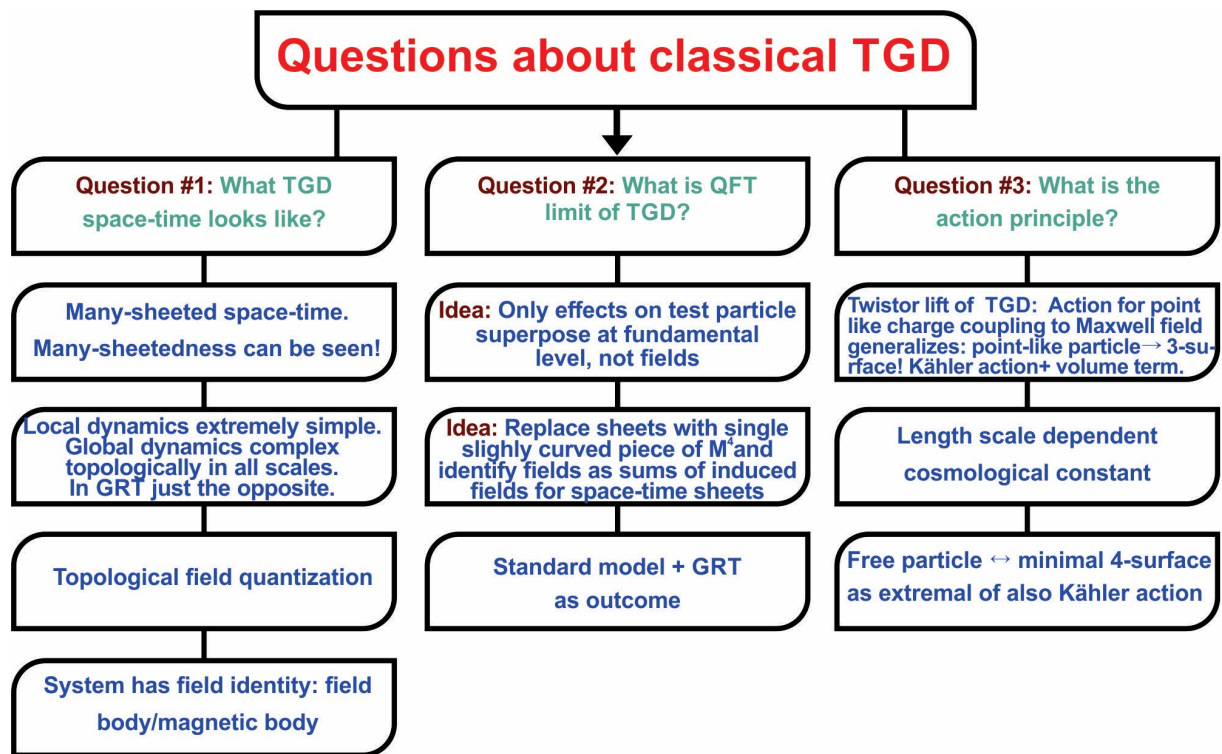
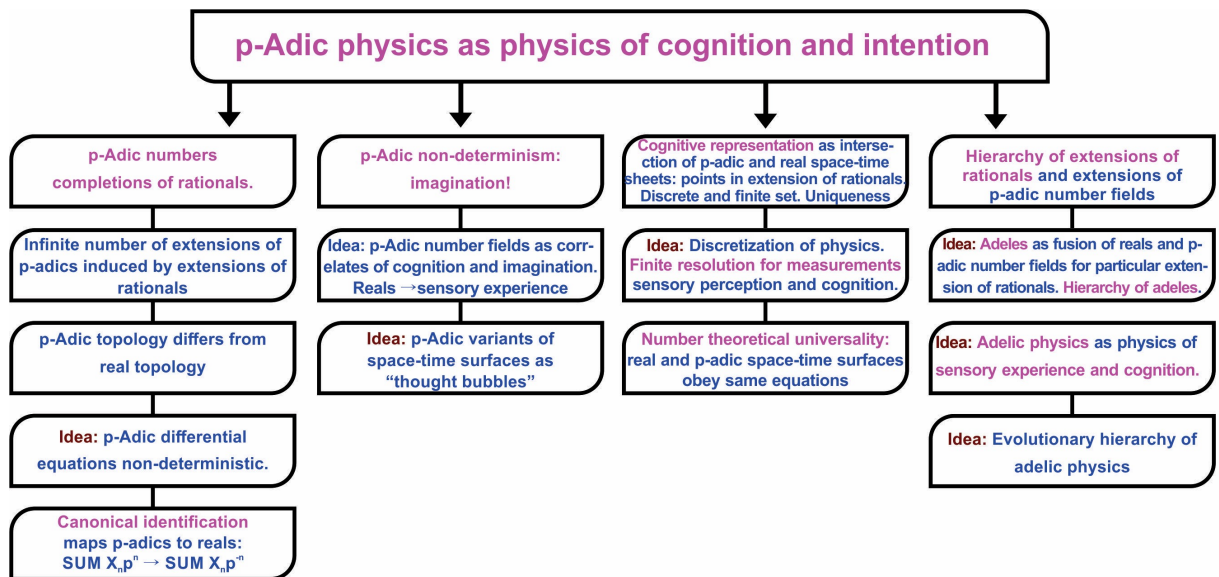


Figure 7: Questions about classical TGD.

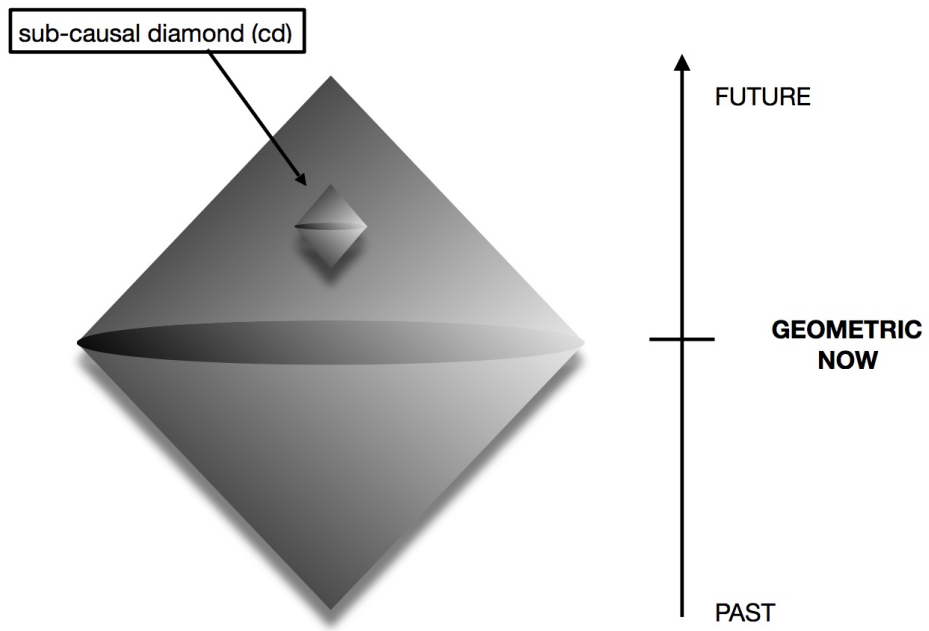


**Figure 8:** p-Adic physics as physics of cognition and imagination.

anomalies of water lead to a model for dark nuclei as dark proton strings with the surprising prediction that DNA, RNA, amino acids and even tRNA are in one-one correspondence with the resulting 3-quark states and that vertebrate genetic code emerges naturally. This leads to a vision about water as primordial lifeform still playing a vital role in living organisms. The model of water memory and homeopathy in turn generalizes to a vision about how immune system might have evolved.

- Metabolic energy is necessary for conscious information processing in living matter. This suggests that metabolism should be basically transfer of negentropic entanglement from nutrients to the organism. ATP could be seen as a molecule of consciousness in this picture and high energy phosphate bond would make possible the transfer of negentropy.
- Pollack effect and its generalizations are in a central role in the TGD inspired quantum biology. In the Pollack effect, the feed of energy allows to increase the value of effective Planck constant so that an ordinary charged particle transforms to its dark variant, being kicked to, say, the gravitational magnetic body of the system itself or some other system such as the Earth or Sun. Charge separation takes place between ordinary biomatter and its magnetic body. Dissipation is extremely small at the magnetic /field body so that Pollack effect makes it possible to realize various biological functions at the magnetic/field body. Photons, in particular solar photons, can provide the energy needed to increase the value of  $h_{eff}$  but there are many other possibilities. For instance, the formation of molecular bound states of atoms liberates energy which can be used in the Pollack effect and this process could generate dark matter at the magnetic and more general field bodies.

### CAUSAL DIAMOND (CD)



**Figure 9:** Causal diamond

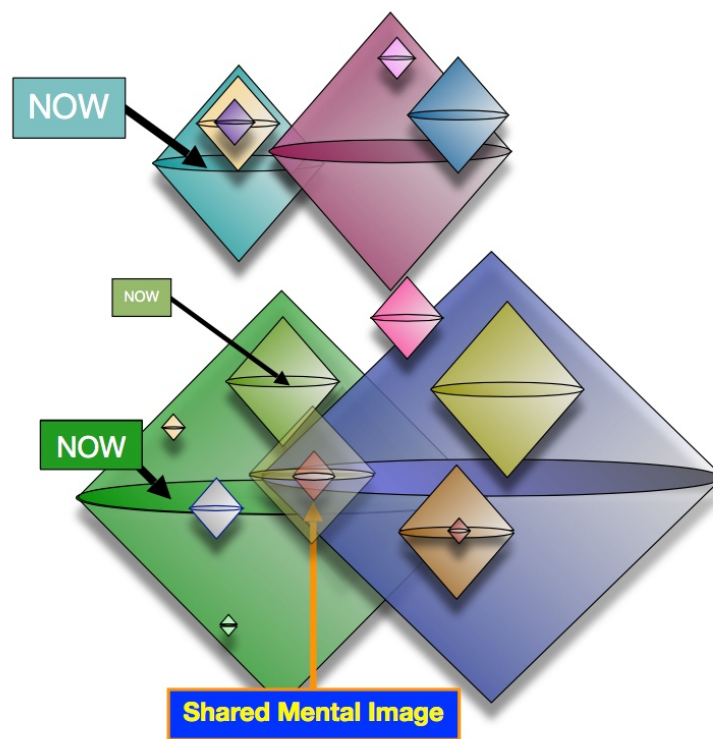


Figure 10: CDs define a fractal “conscious atlas”

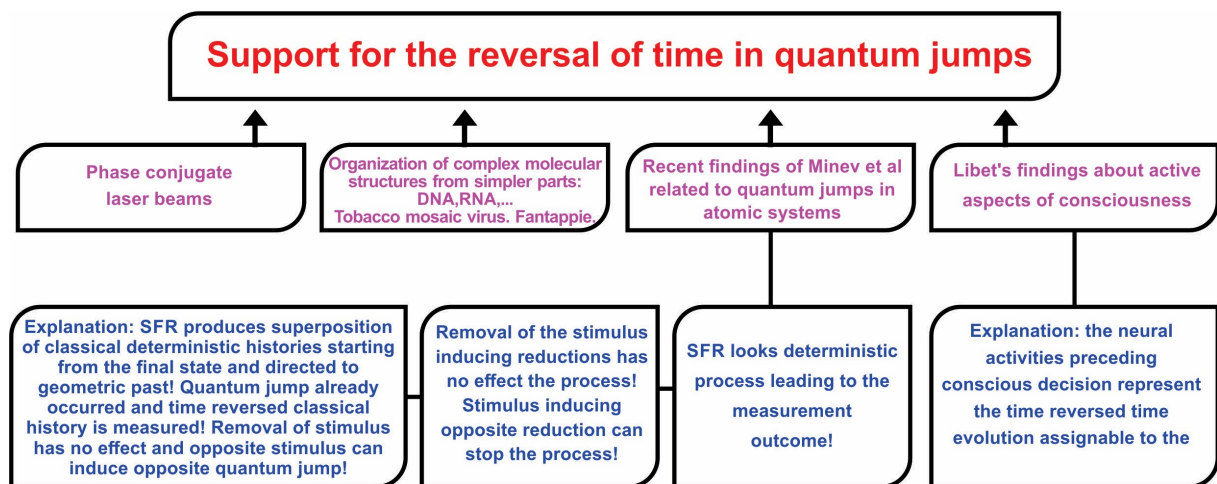


Figure 11: Time reversal occurs in BSFR

## Figures

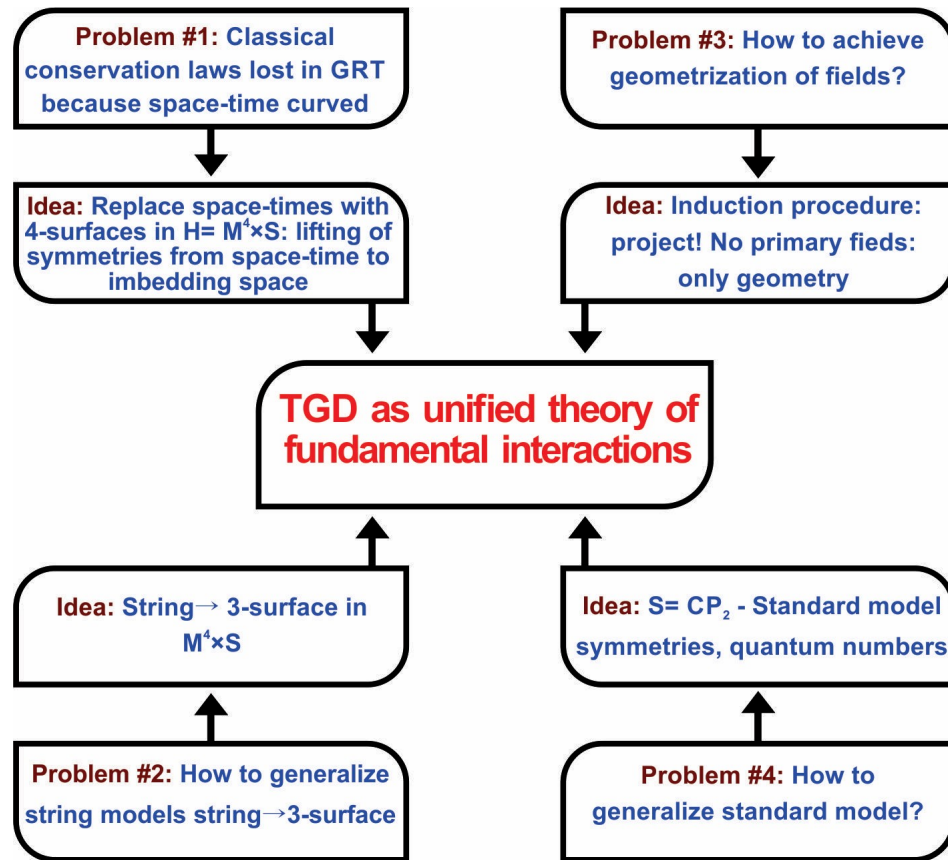


Figure 12: The problems leading to TGD as their solution.

## TGD view of consciousness very briefly

The following is a very brief summary of the basic notions and ideas of TGD inspired theory of consciousness.

- TGD inspired theory of consciousness can be seen as a generalization of quantum measurement theory by bringing in the conscious observer. One can even say that Quantum TGD is basically a theory of conscious experience.

The basic new elements are the resolution of the basic problem of the measurement theory by the introduction of ZEO, which brings new elements also to the quantum measurement theory and leads to a view about how the arrow of time and its flow are generated. Number theoretic physics brings in p-adic physics and the notion of negentropic entanglement. Negentropy Maximization Principle (NMP) was first proposed to serve as a variational principle of consciousness but turned out to follow from number theoretical evolution as a mathematical analog of the second law and implying it. The possibility of negentropic entanglement indeed predicts evolution as gradual increase of negentropic resources of the Universe.

- There are two kinds of state function reductions: the "small" ones (SSFRs) and the "big" ones (BSFRs). The sequence of SSFRs is the counterpart for the repeated measurements of the same observables or at least for a sequence involving measurements of sets of mutually commuting observables such that these sets commute with each other. The state function

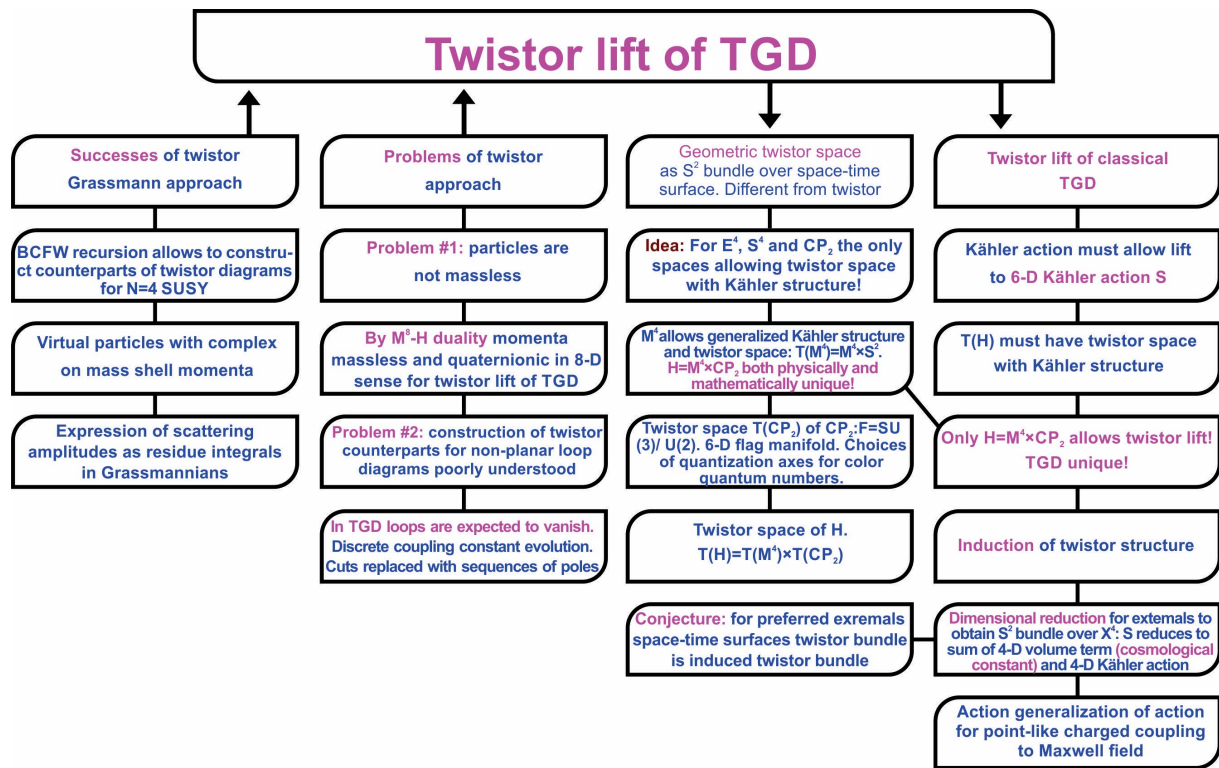
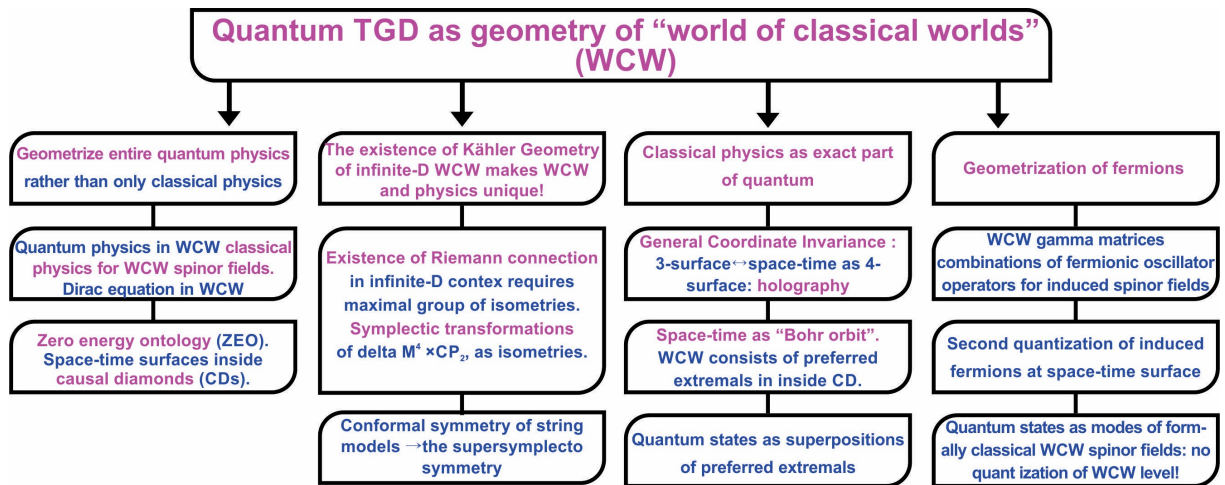


Figure 13: Twistor lift





**Figure 14:** Geometrization of quantum physics in terms of WCW

reductions which leave invariant only the second part of the zero energy state but change the other one: this is the counterpart of the Zeno effect.

Self can be identified as the sequence of SSFRs preceded by the TGD counterparts of unitary time evolutions. The generation of “Akashic records” defined by negentropically entangled systems plays a vital role in the understanding of evolution.

When the set of observables measured in does not commute with the preceding set, SSFR is not possible and BSFR occurs and changes the arrow of time. The roles of the boundaries of CD are changed. Self reincarnates with an opposite arrow of time. Since the classical signals generated by self propagate to opposite time direction, “classical” memories about this period are not possible.

This prediction is something totally new and profoundly affects the view of physics even in cosmological scales since the hierarchy of effective Planck constants allows quantum coherence and consciousness are therefore possible in all scales. For the outsider BSFR looks like a loss of consciousness, death, or falling asleep. The system starts to live consciously in the opposite time direction and reincarnates in the next BSFR.

The strongest simplifying assumption is that the size of CD increases steadily in the sequences of SSFRs. A more precise view is achieved by introducing the finite-dimensional space of CDs. A given SSFR is preceded by a TGD counterpart of a unitary time evolution as a dispersion in the space of CDs. SSFR means a localization in this moduli space and implies the statistical increase of the size CD and the correlation between experienced time as sequence of SSFRs with the geometric time identifiable as the distance between the tips of CD.

- CDs serve as correlates of selves and a hierarchy of selves is predicted and closely relates to

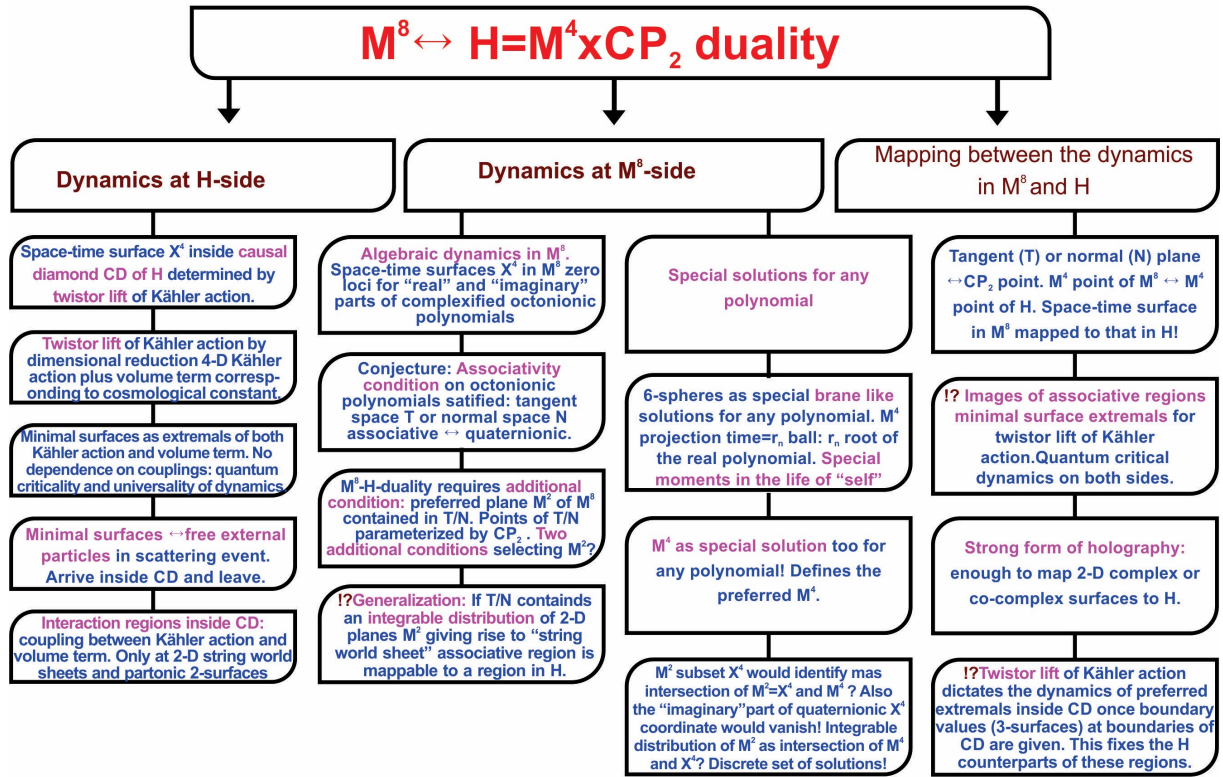


Figure 15:  $M^8 - H$  duality

the p-adic hierarchy and hierarchy of Planck constants. Subselves are interpreted as mental images of self and the sharing of mental images by fusion of subselves gives rise to a kind of stereo consciousness.

## Figures

What I have said above is strongly biased view about the recent situation in quantum TGD. This vision is single man's view and doomed to contain unrealistic elements as I know from experience. My dream is that young critical readers could take this vision seriously enough to try to demonstrate that some of its basic premises are wrong or to develop an alternative based on these or better premises. I must be however honest and tell that 45 years of TGD is a really vast bundle of thoughts and quite a challenge for anyone who is not able to cheat himself by taking the attitude of a blind believer or a light-hearted debunker trusting on the power of easy rhetoric tricks.

Karkkila, April 22, 2024, Finland

Matti Pitkänen

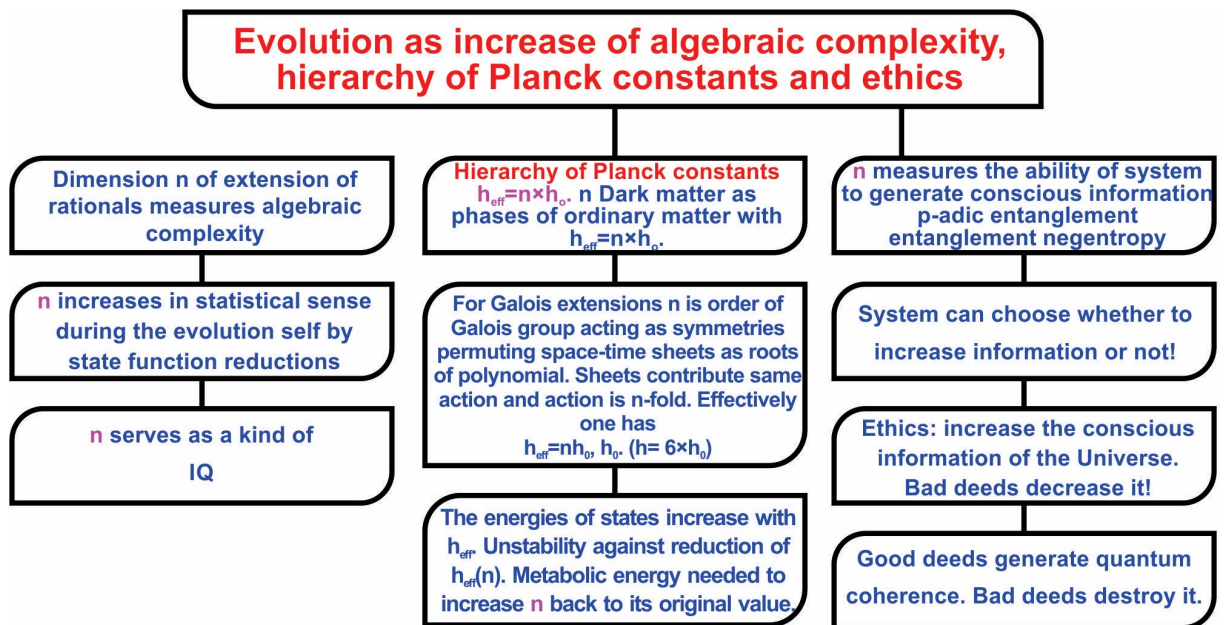


Figure 16: Number theoretic view of evolution

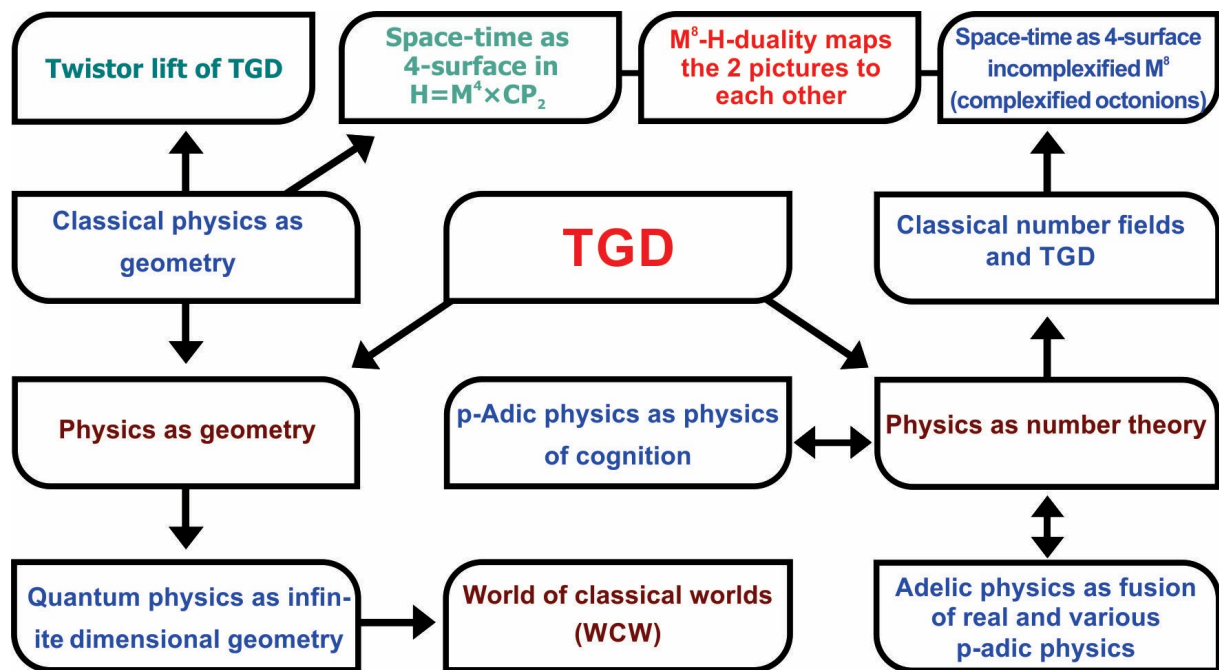


Figure 17: TGD is based on two complementary visions: physics as geometry and physics as number theory.

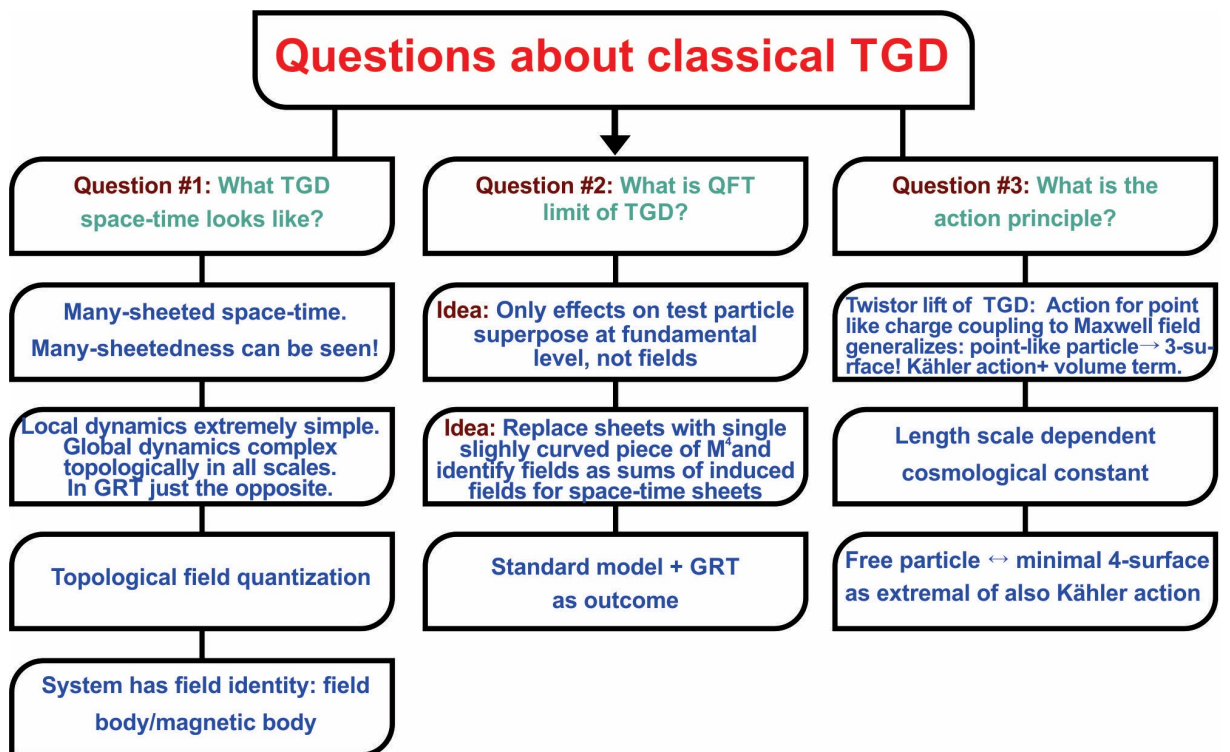


Figure 18: Questions about classical TGD.

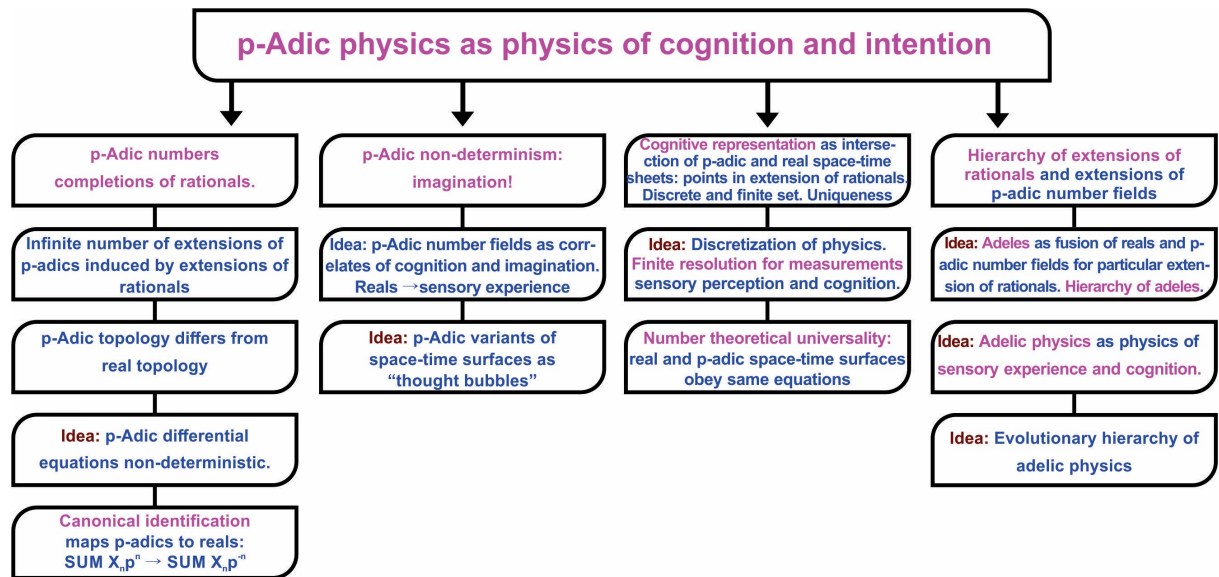
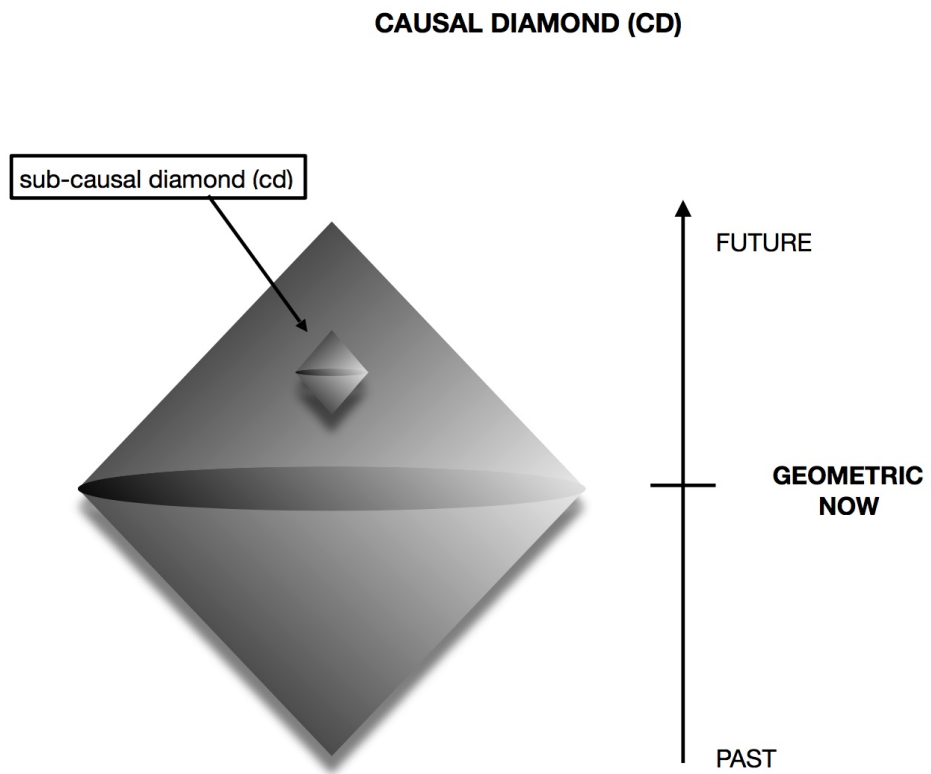


Figure 19: p-Adic physics as physics of cognition and imagination.



**Figure 20:** Causal diamond

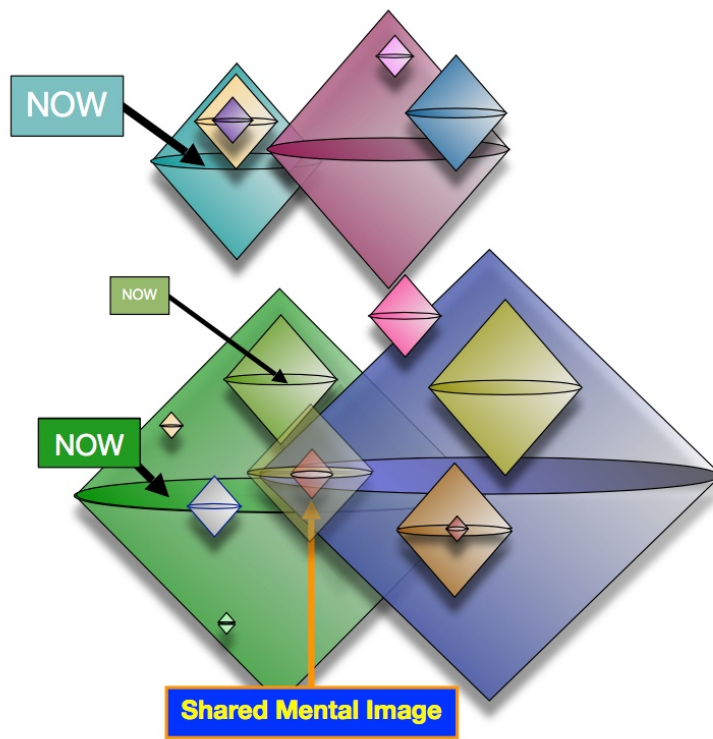


Figure 21: CDs define a fractal “conscious atlas”



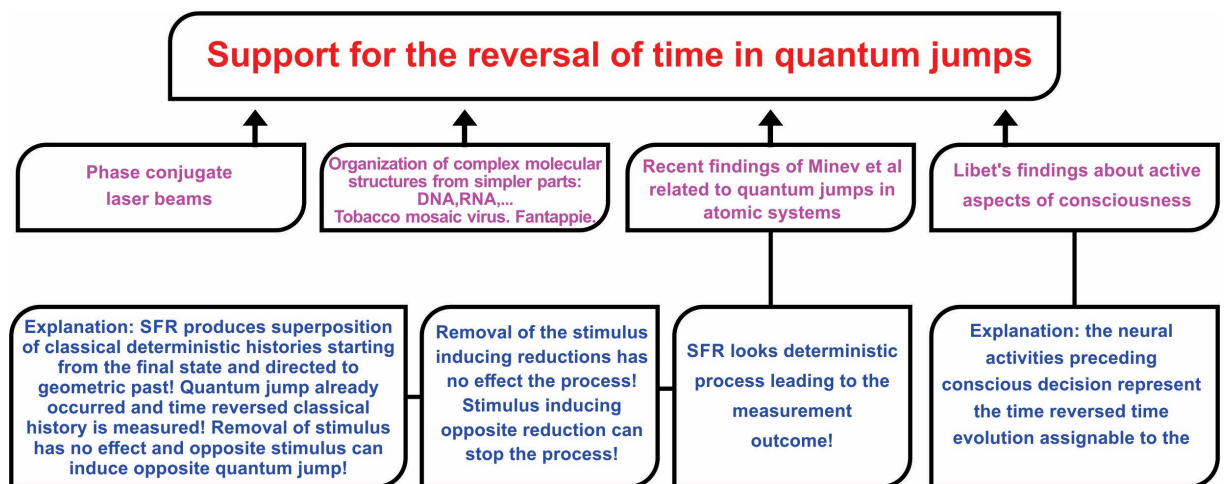


Figure 22: Time reversal occurs in BSFR

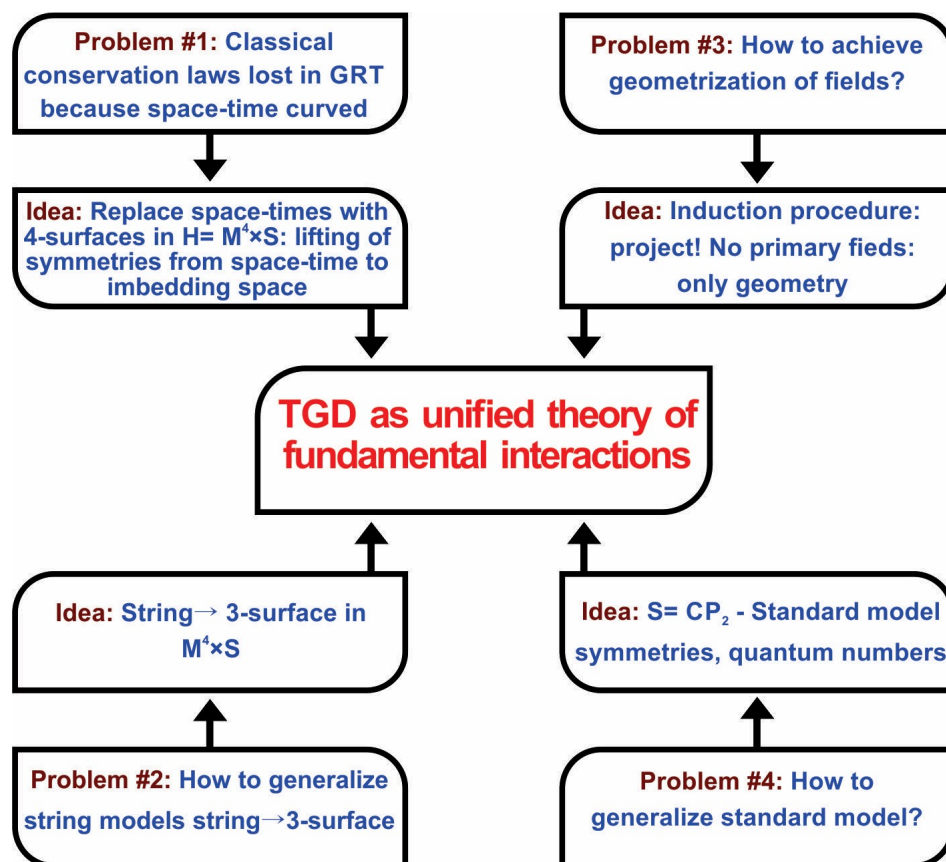


Figure 23: The problems leading to TGD as their solution.

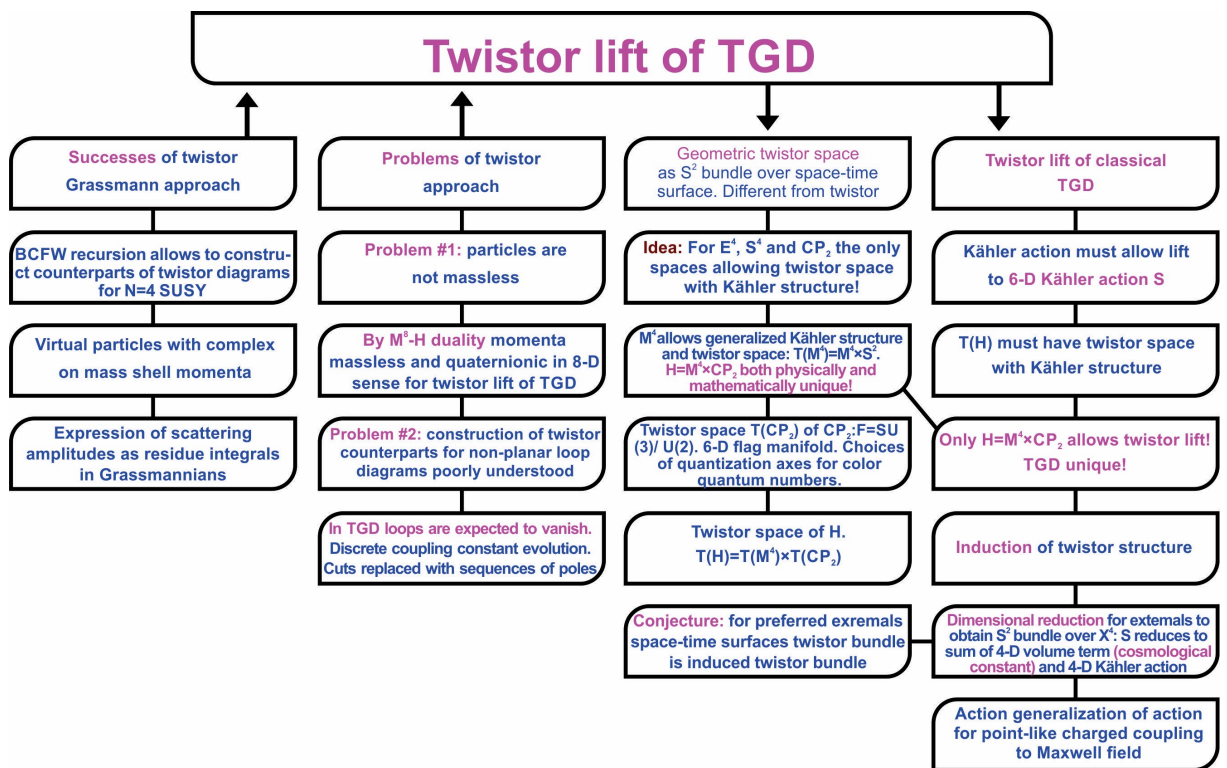
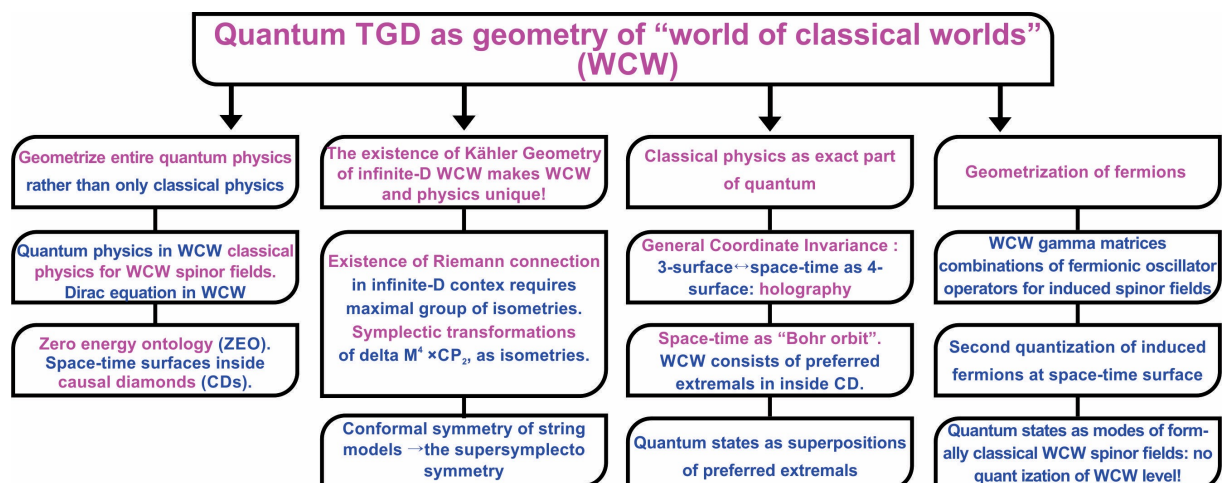


Figure 24: Twistor lift



**Figure 25:** Geometrization of quantum physics in terms of WCW

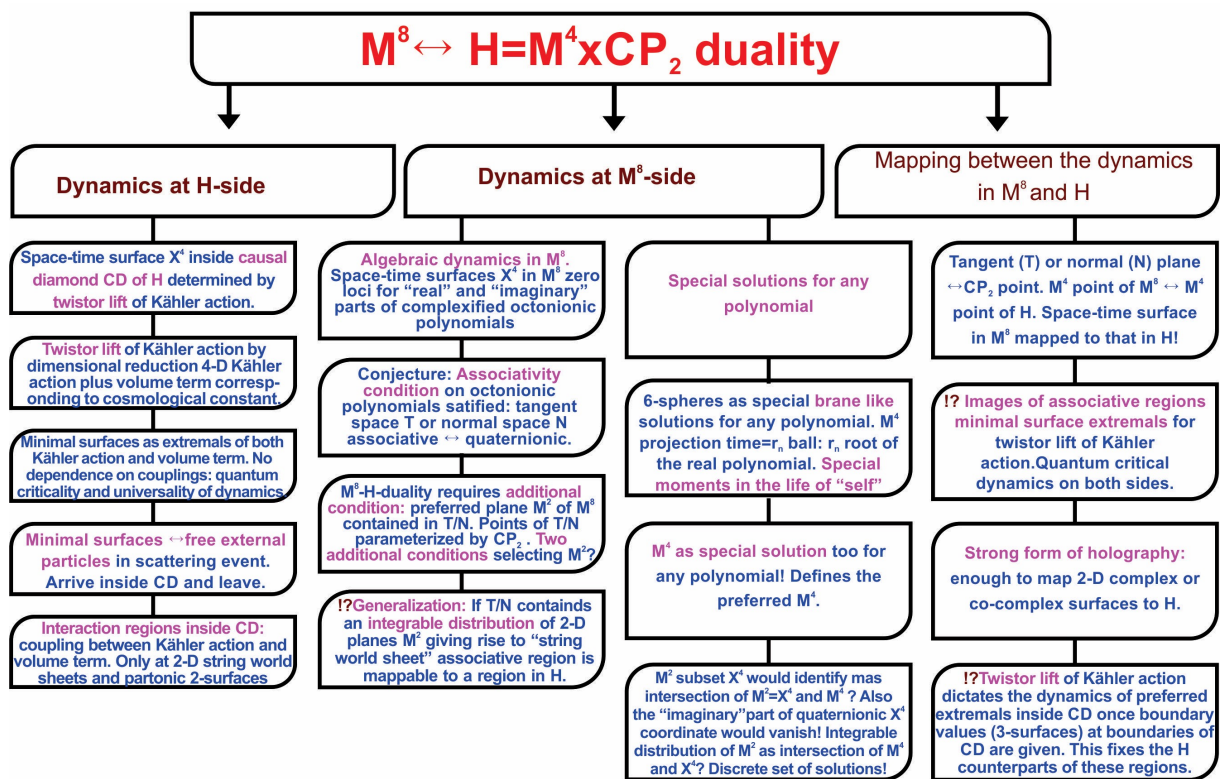


Figure 26:  $M^8 - H$  duality

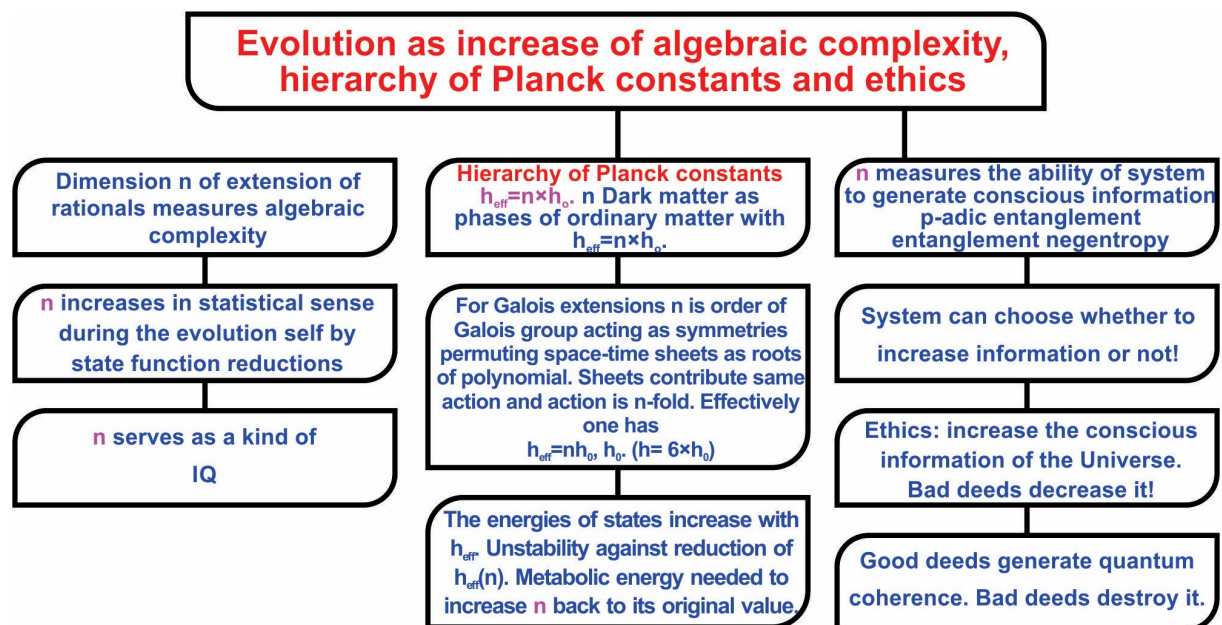
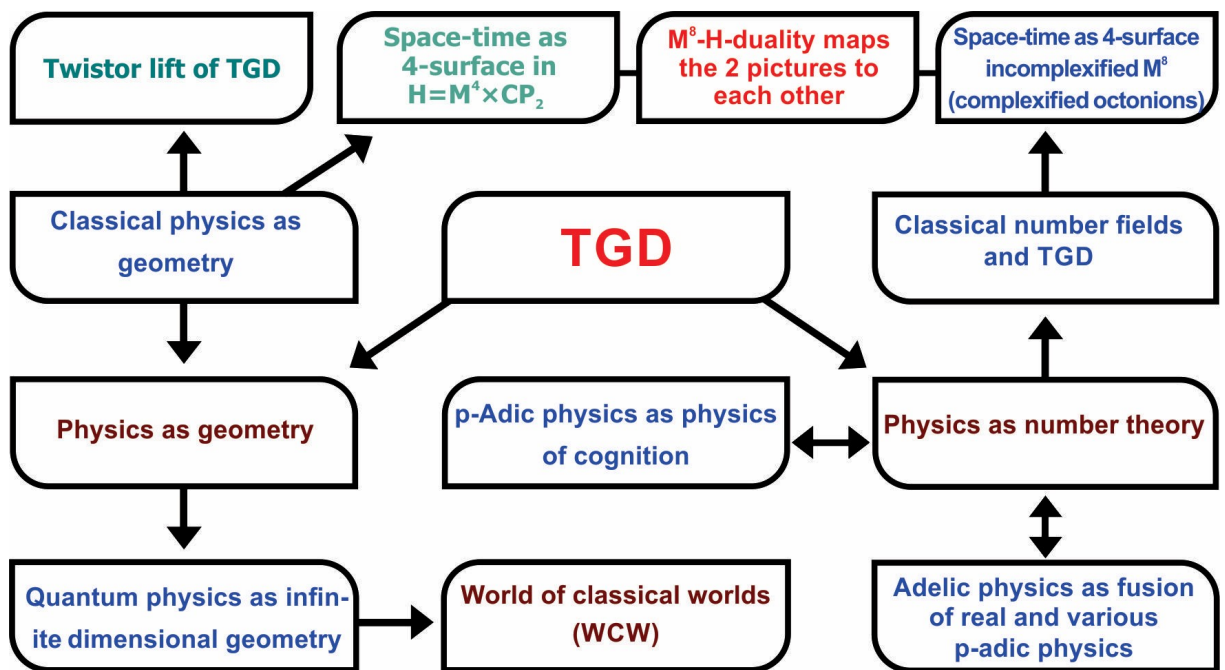


Figure 27: Number theoretic view of evolution



**Figure 28:** TGD is based on two complementary visions: physics as geometry and physics as number theory.

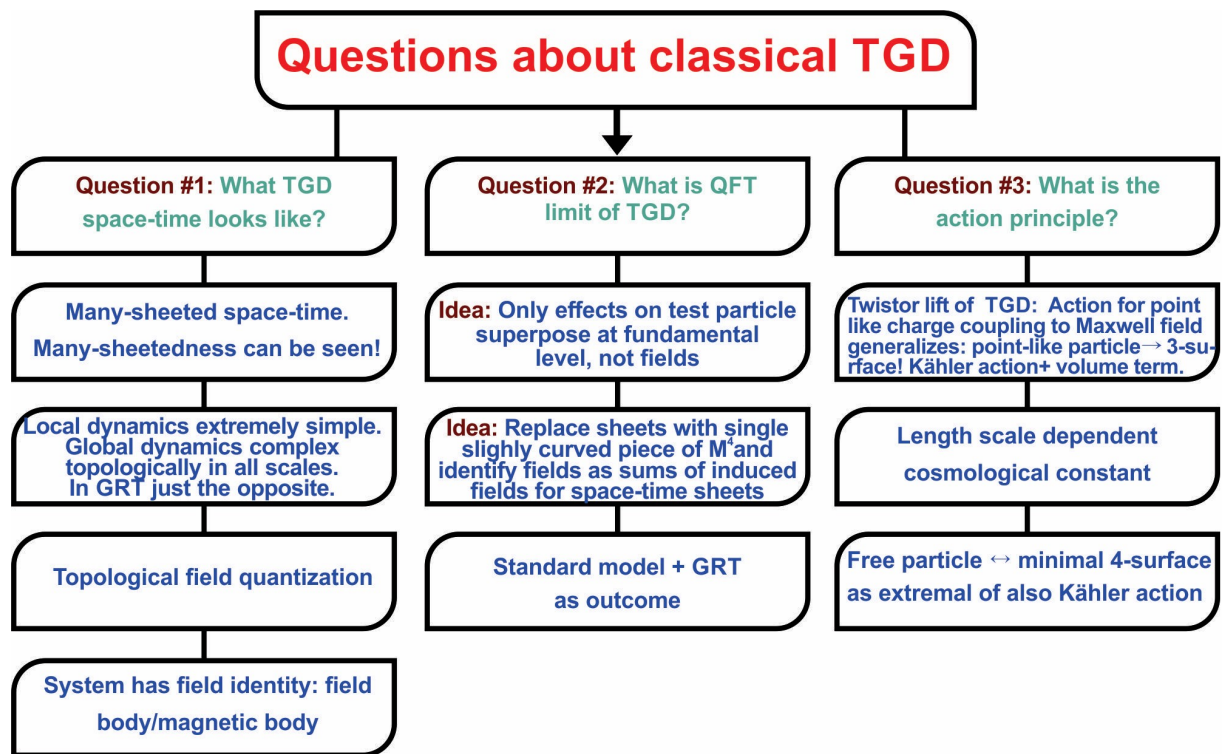


Figure 29: Questions about classical TGD.



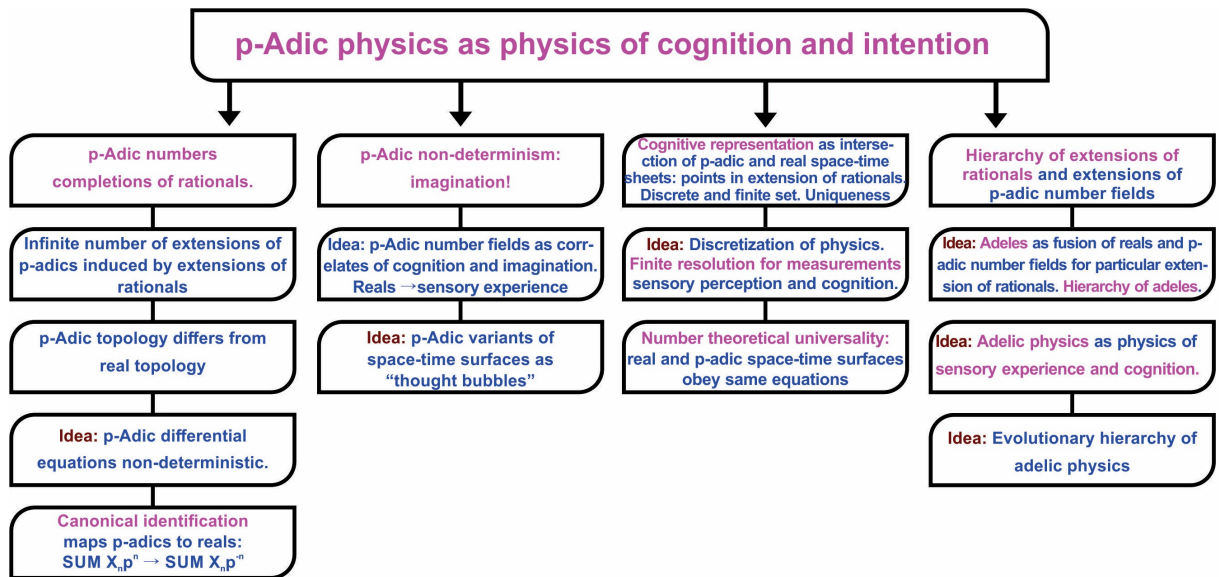
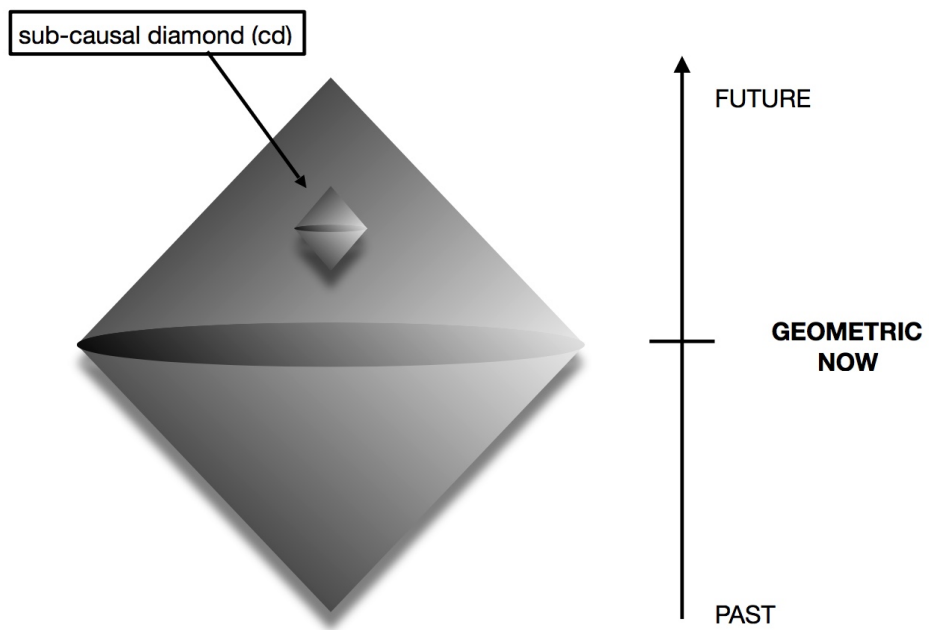


Figure 30: p-Adic physics as physics of cognition and imagination.

**CAUSAL DIAMOND (CD)**



**Figure 31:** Causal diamond

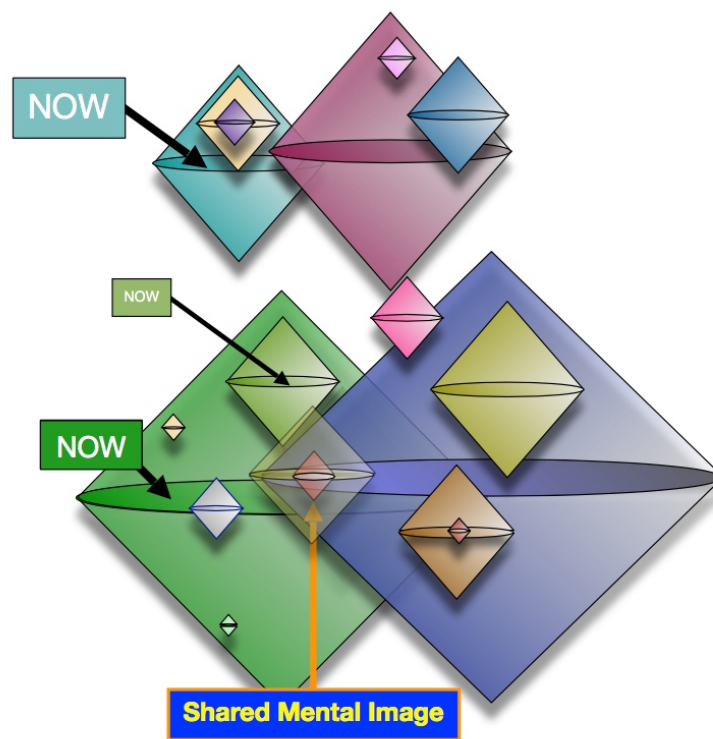


Figure 32: CDs define a fractal “conscious atlas”

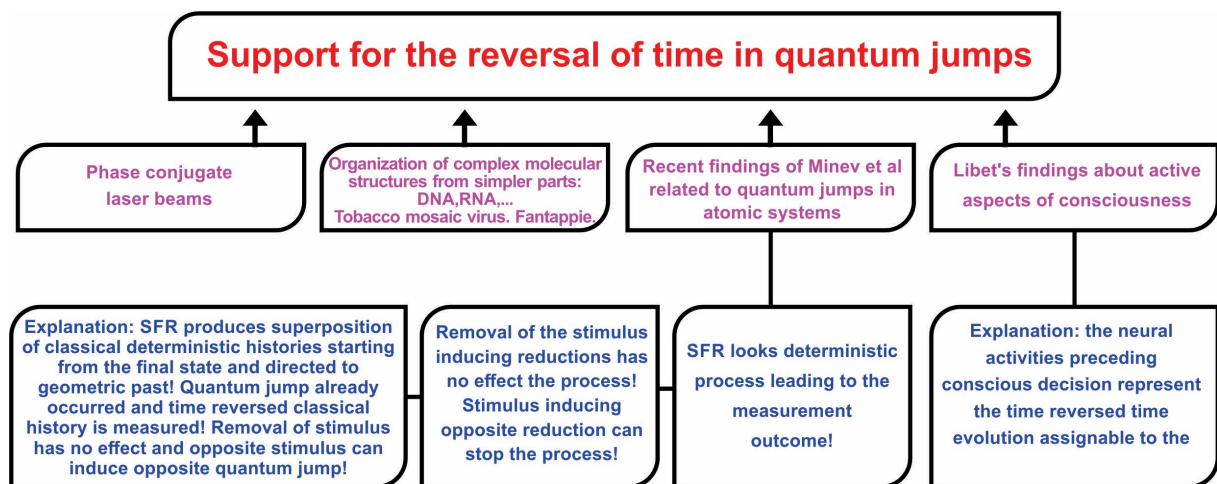


Figure 33: Time reversal occurs in BSFR

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Neither TGD nor these books would exist without the help and encouragement of many people. The friendship with Heikki and Raija Haila and their family and Kalevi and Ritva Tikkanen and their family have been kept me in contact with the everyday world and without this friendship I would not have survived through these lonely 45 lonely years most of which I have remained unemployed as a scientific dissident. I am happy that my children have understood my difficult position and like my friends have believed that what I am doing is something valuable although I have not received any official recognition for it.

During the last decade Tapio Tammi has helped me quite concretely by providing the necessary computer facilities and being one of the few persons in Finland with whom to discuss my work. Pertti Kärkkäinen is my old physicist friend and has provided continued economic support for a long time. I have also had stimulating discussions with Samuli Penttinen who has also helped to get through the economical situations in which there seemed to be no hope. The continual updating of fifteen online books means quite a heavy bureaucracy at the level of bits and without a systemization one ends up with endless copying and pasting and internal consistency is soon lost. Tommi Ullgren has provided both economic support and encouragement during years. Pekka Rapinoja has offered his help in this respect and I am especially grateful to him for my Python skills.

During the last five years I have had inspiring discussions with many people in Finland interested in TGD. We have had video discussions with Sini Kunnas and had podcast discussions with Marko Manninen related to the TGD based view of physics and consciousness. Marko has also helped in the practical issues related to computers and quite recently he has done a lot of testing of chatGPT helping me to get an overall view of what it is. The discussions in a Zoom group involving Marko Manninen, Tuomas Sorakivi and Rode Majakka have given me the valuable opportunity to clarify my thoughts.

The collaboration with Lian Sidorov was extremely fruitful and she also helped me to survive economically through the hardest years. The participation in CASYS conferences in Liege has been an important window to the academic world and I am grateful for Daniel Dubois and Peter Marcer for making this participation possible. The discussions and collaboration with Eduardo de Luna and Istvan Dienes stimulated the hope that the communication of new vision might not be a mission impossible after all. Also blog discussions have been very useful. During these years I have received innumerable email contacts from people around the world. I am grateful to Mark McWilliams, Paul Kirsch, Gary Ehlenberg, and Ulla Matfolk and many others for providing links to possibly interesting websites and articles. We have collaborated with Peter Gariaev and Reza Rastmanesh. These contacts have helped me to avoid the depressive feeling of being some kind of Don Quixote of Science and helped me to widen my views: I am grateful for all these people.

In the situation in which the conventional scientific communication channels are strictly closed it is important to have some loop hole through which the information about the work done can at least in principle leak to the public through the iron wall of academic censorship. Without any exaggeration I can say that without the world wide web I would not have survived as a scientist nor as an individual. Homepage and blog are however not enough since only the formally published result is a result in recent day science. Publishing is however impossible without direct support from power holders- even in archives like arXiv.org.

Situation changed as Andrew Adamatsky proposed the writing of a book about TGD when I had already gotten used to the thought that my work would not be published during my lifetime. The Prespacetime Journal and two other journals related to quantum biology and consciousness - all of them founded by Huping Hu - have provided this kind of loophole. In particular, Dainis Zeps,

Phil Gibbs, and Arkadiusz Jadczyk deserve my gratitude for their kind help in the preparation of an article series about TGD catalyzing a considerable progress in the understanding of quantum TGD. Also the viXra archive founded by Phil Gibbs and its predecessor Archive Freedom have been of great help: Victor Christianto deserves special thanks for doing the hard work needed to run Archive Freedom. Also the Neuroquantology Journal founded by Sultan Tarlaci deserves a special mention for its publication policy.

And last but not least: there are people who experience as a fascinating intellectual challenge to spoil the practical working conditions of a person working with something which might be called unified theory: I am grateful for the people who have helped me to survive through the virus attacks, an activity which has taken roughly one month per year during the last half decade and given a strong hue of grey to my hair.

For a person approaching his 73th birthday it is somewhat easier to overcome the hard feelings due to the loss of academic human rights than for an inpatient youngster. Unfortunately the economic situation has become increasingly difficult during the twenty years after the economic depression in Finland which in practice meant that Finland ceased to be a constitutional state in the strong sense of the word. It became possible to depose people like me from society without fear about public reactions and the classification as dropout became a convenient tool of ridicule to circumvent the ethical issues. During the period when the right wing held political power this trend was steadily strengthening and the situation is the same as I am writing this. In this kind of situation the concrete help from individuals has been and will be of utmost importance. Against this background it becomes obvious that this kind of work is not possible without the support from outside and I apologize for not being able to mention all the people who have helped me during these years.

Karkkila, August 30, 2023, Finland

**Matti Pitkänen**

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# Chapter 1

## Introduction

### 1.1 Basic Ideas of Topological Geometrodynamics (TGD)

Standard model describes rather successfully both electroweak and strong interactions but sees them as totally separate and contains a large number of parameters which it is not able to predict. For about four decades ago unified theories known as Grand Unified Theories (GUTs) trying to understand electroweak interactions and strong interactions as aspects of the same fundamental gauge interaction assignable to a larger symmetry group emerged. Later superstring models trying to unify even gravitation and strong and weak interactions emerged. The shortcomings of both GUTs and superstring models are now well-known. If TGD - whose basic idea emerged towards the end of 1977 - would emerge now it would be seen as an attempt to solve the difficulties of these approaches to unification.

The basic physical picture behind the geometric vision of TGD corresponds to a fusion of two rather disparate approaches: namely TGD as a Poincare invariant theory of gravitation and TGD as a generalization of the old-fashioned string model. After 1995 number theoretic vision started to develop and was initiated by the success of mass calculations based on p-adic thermodynamics. Number theoretic vision involves all number fields and is complementary to the geometric vision: one can say that this duality is analogous to momentum-position duality of wave mechanics. TGD can be also regarded as topological quantum theory in a very general sense as already the attribute "Topological" in "TGD" makes clear. Space-time surfaces as minimal surfaces can be regarded as representatives of homology equivalence classes and p-adic topologies generalize the notion of local topology and apply to the description of correlates of cognition.

#### 1.1.1 Geometric Vision Very Briefly

*T(opological) G(eometro)D(ynamics)* is one of the many attempts to find a unified description of basic interactions. The development of the basic ideas of TGD to a relatively stable form took time of about half decade [K2].

The basic vision and its relationship to existing theories is now rather well understood.

1. Space-times are representable as 4-surfaces in the 8-dimensional embedding space  $H = M^4 \times CP_2$ , where  $M^4$  is 4-dimensional (4-D) Minkowski space and  $CP_2$  is 4-D complex projective space (see Appendix).
2. Induction procedure (a standard procedure in fiber bundle theory, see Appendix) allows to geometrize various fields. Space-time metric characterizing gravitational fields corresponds to the induced metric obtained by projecting the metric tensor of  $H$  to the space-time surface. Electroweak gauge potentials are identified as projections of the components of  $CP_2$  spinor connection to the space-time surface, and color gauge potentials as projections of  $CP_2$  Killing vector fields representing color symmetries. Also spinor structure can be induced: induced spinor gamma matrices are projections of gamma matrices of  $H$  and induced spinor fields just  $H$  spinor fields restricted to space-time surface. Spinor connection is also projected. The interpretation is that distances are measured in embedding space metric and parallel translation using spinor connection of embedding space.

Twistor lift of TGD means that one can lift space-time surfaces in  $H$  to 6-D surfaces a analogs of twistor space of space-time surface in the Cartesian product of the twistor spaces of  $M^4$  and  $CP_2$ , which are the only 4-manifolds allowing twistor space with Kähler structure [A12]. The twistor structure would be induced in some sense, and should coincide with that associated with the induced metric. Clearly, the 2-spheres defining the fibers of twistor spaces of  $M^4$  and  $CP_2$  must allow identification: this 2-sphere defines the  $S^2$  fiber of the twistor space of the space-time surface. This poses a constraint on the embedding of the twistor space of space-time surfaces as sub-manifold in the Cartesian product of twistor spaces. The existence of Kähler structure allows to lift 4-D Kähler action to its 6-D counterparts and the 6-D counterpart of twistor space is obtained by its dimensional reduction so that one obtains a sphere bundle. This makes possible twistorialization for all space-time surfaces: in general relativity the general metric does not allow this.

3. A geometrization of quantum numbers is achieved. The isometry group of the geometry of  $CP_2$  codes for the color gauge symmetries of strong interactions. Vierbein group codes for electroweak symmetries, and explains their breaking in terms of  $CP_2$  geometry so that standard model gauge group results. There are also important deviations from the standard model: color quantum numbers are not spin-like but analogous to orbital angular momentum: this difference is expected to be seen only in  $CP_2$  scale. In contrast to GUTs, quark and lepton numbers are separately conserved and family replication has a topological explanation in terms of topology of the partonic 2-surface carrying fermionic quantum numbers.

$M^4$  and  $CP_2$  are unique choices for many other reasons. For instance, they are the unique 4-D space-times allowing twistor space with Kähler structure.  $M^4$  light-cone boundary allows a huge extension of 2-D conformal symmetries.  $M^4$  and  $CP_2$  allow quaternionic structures. Therefore standard model symmetries have number theoretic meaning.

4. Induced gauge potentials are expressible in terms of embedding space coordinates and their gradients and general coordinate invariance implies that there are only 4 field-like variables locally. Situation is thus extremely simple mathematically. The objection is that one loses linear superposition of fields. The resolution of the problem comes from the generalization of the concepts of particle and space-time.

Space-time surfaces can be also particle like having thus finite size. In particular, space-time regions with Euclidian signature of the induced metric (temporal and spatial dimensions in the same role) emerge and have interpretation as lines of generalized Feynman diagrams. Particles in space-time can be identified as a topological inhomogeneities in background space-time surface which looks like the space-time of general relativity in long length scales.

One ends up with a generalization of space-time surface to many-sheeted space-time with space-time sheets having extremely small distances of about  $10^4$  Planck lengths ( $CP_2$  size). As one adds a particle to this kind of structure, it touches various space-time sheets and thus interacts with the associated classical fields. Their effects superpose linearly in good approximation and linear superposition of fields is replaced with that for their effects.

This resolves the basic objection. It also leads to the understanding of how the space-time of general relativity and quantum field theories emerges from TGD space-time as effective space-time when the sheets of many-sheeted space-time are lumped together to form a region of Minkowski space with metric replaced with a metric identified as the sum of empty Minkowski metric and deviations of the metrics of sheets from empty Minkowski metric. Gauge potentials are identified as sums of the induced gauge potentials. TGD is therefore a microscopic theory from which the standard model and general relativity follow as a topological simplification, however forcing a dramatic increase of the number of fundamental field variables.

5. A further objection is that classical weak fields identified as induced gauge fields are long ranged and should cause large parity breaking effects due to weak interactions. These effects are indeed observed but only in living matter. The basic problem is that one has long ranged classical electroweak gauge fields. The resolution of the problem is that the quantum averages of induced weak and color gauge fields vanish due to the fact that color rotations affect both space-time surfaces and induced weak and color fields. Only the averages of



electromagnetic fields are nonvanishing. The correlations functions for weak fields are nonvanishing below Compton lengths of weak bosons. In living matter large values of effective Planck constant labelling phases of ordinary matter identified as dark matter make possible long ranged weak fields and color fields.

6. General coordinate invariance requires holography so that space-time surfaces are analogous to Bohr orbits for particles identified as 3-surfaces. Bohr orbit property would be naturally realized by a 4-D generalization of holomorphy of string world sheets and implies that the space-time surfaces are minimal surfaces apart from singularities. This holds true for any action as long as it is general coordinate invariant and constructible in terms of the induced geometry. String world sheets and light-like orbits of partonic 2-surfaces correspond to singularities at which the minimal surface property of the space-time surfaces realizing the preferred extremal property fails. Preferred extremals are not completely deterministic, which implies what I call zero energy ontology (ZEO) meaning that the Bohr orbits are the fundamental objects. This leads to a solution of the basic paradox of quantum measurement theory. Also the mathematically ill-defined path integral disappears and leaves only the well-defined functional integral over the Bohr orbits.
7. A string model-like picture emerges from TGD and one ends up with a rather concrete view about the topological counterpart of Feynman diagrammatics. The natural stringy action would be given by the string world sheet area, which is present only in the space-time regions with Minkowskian signature. Gravitational constant could be present as a fundamental constant in string action and the ratio  $\hbar/G/R^2$  would be determined by quantum criticality conditions. The hierarchy of Planck constants  $\hbar_{eff}/\hbar = n$  assigned to dark matter in TGD framework would allow to circumvent the objection that only objects of length of order Planck length are possible since string tension given by  $T = 1/\hbar_{eff}G$  apart from numerical factor could be arbitrary small. This would make possible gravitational bound states as partonic 2-surfaces as structures connected by strings and solve the basic problem of superstring theories. This option allows the natural interpretation of  $M^4$  type vacuum extremals with  $CP_2$  projection, which is Lagrange manifold as good approximations for space-time sheets at macroscopic length scales. String area does not contribute to the Kähler function at all.

Whether induced spinor fields associated with Kähler-Dirac action and de-localized inside the entire space-time surface should be allowed remains an open question: super-conformal symmetry strongly suggests their presence. A possible interpretation for the corresponding spinor modes could be in terms of dark matter, sparticles, and hierarchy of Planck constants.

It is perhaps useful to make clear what TGD is not and also what new TGD can give to physics.

1. TGD is *not* just General Relativity made concrete by using embeddings: the 4-surface property is absolutely essential for unifying standard model physics with gravitation and to circumvent the incurable conceptual problems of General Relativity. The many-sheeted space-time of TGD gives rise only at the macroscopic limit to GRT space-time as a slightly curved Minkowski space. TGD is *not* a Kaluza-Klein theory although color gauge potentials are analogous to gauge potentials in these theories.

TGD space-time is 4-D and its dimension is due to completely unique conformal properties of light-cone boundary and 3-D light-like surfaces implying enormous extension of the ordinary conformal symmetries. Light-like 3-surfaces represent orbits of partonic 2-surfaces and carry fundamental fermions at 1-D boundaries of string world sheets. TGD is *not* obtained by performing Poincare gauging of space-time to introduce gravitation and is plagued by profound conceptual problems.

2. TGD is *not* a particular string model although string world sheets emerge in TGD very naturally as loci for spinor modes: their 2-dimensionality makes among other things possible quantum deformation of quantization known to be physically realized in condensed matter, and conjectured in TGD framework to be crucial for understanding the notion of finite measurement resolution. Hierarchy of objects of dimension up to 4 emerge from TGD: this obviously means analogy with branes of super-string models.

TGD is *not* one more item in the collection of string models of quantum gravitation relying on Planck length mystics. Dark matter becomes an essential element of quantum gravitation and quantum coherence in astrophysical scales is predicted just from the assumption that strings connecting partonic 2-surfaces are responsible for gravitational bound states.

TGD is *not* a particular string model although AdS/CFT duality of super-string models generalizes due to the huge extension of conformal symmetries and by the identification of WCW gamma matrices as Noether super-charges of super-symplectic algebra having a natural conformal structure.

3. TGD is *not* a gauge theory. In TGD framework the counterparts of also ordinary gauge symmetries are assigned to super-symplectic algebra (and its Yangian [A3] [B7, B5, B6]), which is a generalization of Kac-Moody algebras rather than gauge algebra and suffers a fractal hierarchy of symmetry breakings defining hierarchy of criticalities. TGD is *not* one more quantum field theory like structure based on path integral formalism: path integral is replaced with functional integral over 3-surfaces, and the notion of classical space-time becomes an exact part of the theory. Quantum theory becomes formally a purely classical theory of WCW spinor fields: only state function reduction is something genuinely quantal.
4. TGD view about spinor fields is *not* the standard one. Spinor fields appear at three levels. Spinor modes of the embedding space are analogs of spinor modes characterizing incoming and outgoing states in quantum field theories. Induced second quantized spinor fields at space-time level are analogs of stringy spinor fields. Their modes are localized by the well-definedness of electro-magnetic charge and by number theoretic arguments at string world sheets. Kähler-Dirac action is fixed by supersymmetry implying that ordinary gamma matrices are replaced by what I call Kähler-Dirac gamma matrices - this something new. WCW spinor fields, which are classical in the sense that they are not second quantized, serve as analogs of fields of string field theory and imply a geometrization of quantum theory.
5. TGD is in some sense an extremely conservative geometrization of entire quantum physics: *no* additional structures such as gauge fields as independent dynamical degrees of freedom are introduced: Kähler geometry and associated spinor structure are enough. “Topological” in TGD should not be understood as an attempt to reduce physics to torsion (see for instance [B4]) or something similar. Rather, TGD space-time is topologically non-trivial in all scales and even the visible structures of the everyday world represent non-trivial topology of space-time in the TGD Universe.
6. Twistor space - or rather, a generalization of twistor approach replacing masslessness in 4-D sense with masslessness in 8-D sense and thus allowing description of also massive particles - emerged originally as a technical tool, and its Kähler structure is possible only for  $H = M^4 \times CP_2$ . It however turned out that much more than a technical tool is in question. What is genuinely new is the infinite-dimensional character of the Kähler geometry making it highly unique, and its generalization to p-adic number fields to describe correlates of cognition. Also the hierarchy of Planck constants  $h_{eff} = n \times h$  reduces to the quantum criticality of the TGD Universe and p-adic length scales and Zero Energy Ontology represent something genuinely new.

The great challenge is to construct a mathematical theory around these physically very attractive ideas and I have devoted the last 45 years to the realization of this dream and this has resulted in 26 online books about TGD and nine online books about TGD inspired theory of consciousness and of quantum biology.

A collection of 30 online books is now (August 2023) under preparation. The goal is to minimize overlap between the topics of the books and make the focus of a given book sharper.

### 1.1.2 Two Visions About TGD as Geometrization of Physics and Their Fusion

As already mentioned, TGD as a geometrization of physics can be interpreted both as a modification of general relativity and generalization of string models.

### TGD as a Poincare Invariant Theory of Gravitation

The first approach was born as an attempt to construct a Poincare invariant theory of gravitation. Space-time, rather than being an abstract manifold endowed with a pseudo-Riemannian structure, is regarded as a surface in the 8-dimensional space  $H = M^4 \times CP_2$ , where  $M^4$  denotes Minkowski space and  $CP_2 = SU(3)/U(2)$  is the complex projective space of two complex dimensions [A8, A11, A6, A10].

The identification of the space-time as a sub-manifold [A9, A15] of  $M^4 \times CP_2$  leads to an exact Poincare invariance and solves the conceptual difficulties related to the definition of the energy-momentum in General Relativity.

It soon however turned out that sub-manifold geometry, being considerably richer in structure than the abstract manifold geometry, leads to a geometrization of all basic interactions. First, the geometrization of the elementary particle quantum numbers is achieved. The geometry of  $CP_2$  explains electro-weak and color quantum numbers. The different H-chiralities of  $H$ -spinors correspond to the conserved baryon and lepton numbers. Secondly, the geometrization of the field concept results. The projections of the  $CP_2$  spinor connection, Killing vector fields of  $CP_2$  and of  $H$ -metric to four-surface define classical electro-weak, color gauge fields and metric in  $X^4$ .

The choice of  $H$  is unique from the condition that TGD has standard model symmetries. Also number theoretical vision selects  $H = M^4 \times CP_2$  uniquely.  $M^4$  and  $CP_2$  are also unique spaces allowing twistor space with Kähler structure.

### TGD as a Generalization of the Hadronic String Model

The second approach was based on the generalization of the mesonic string model describing mesons as strings with quarks attached to the ends of the string. In the 3-dimensional generalization 3-surfaces correspond to free particles and the boundaries of the 3- surface correspond to partons in the sense that the quantum numbers of the elementary particles reside on the boundaries. Various boundary topologies (number of handles) correspond to various fermion families so that one obtains an explanation for the known elementary particle quantum numbers. This approach leads also to a natural topological description of the particle reactions as topology changes: for instance, two-particle decay corresponds to a decay of a 3-surface to two disjoint 3-surfaces.

This decay vertex does not however correspond to a direct generalization of trouser vertex of string models. Indeed, the important difference between TGD and string models is that the analogs of string world sheet diagrams do not describe particle decays but the propagation of particles via different routes. Particle reactions are described by generalized Feynman diagrams for which 3-D light-like surface describing particle propagating join along their ends at vertices. As 4-manifolds the space-time surfaces are therefore singular like Feynman diagrams as 1-manifolds.

Quite recently, it has turned out that fermionic strings inside space-time surfaces define an exact part of quantum TGD and that this is essential for understanding gravitation in long length scales. Also the analog of AdS/CFT duality emerges in that the Kähler metric can be defined either in terms of Kähler function identifiable as Kähler action assignable to Euclidian space-time regions or Kähler action + string action assignable to Minkowskian regions.

The recent view about construction of scattering amplitudes is very “stringy”. By strong form of holography string world sheets and partonic 2-surfaces provide the data needed to construct scattering amplitudes. Space-time surfaces are however needed to realize quantum-classical correspondence necessary to understand the classical correlates of quantum measurement. There is a huge generalization of the duality symmetry of hadronic string models.

The proposal is that scattering amplitudes can be regarded as sequences of computational operations for the Yangian of super-symplectic algebra. Product and co-product define the basic vertices and realized geometrically as partonic 2-surfaces and algebraically as multiplication for the elements of Yangian identified as super-symplectic Noether charges assignable to strings. Any computational sequences connecting given collections of algebraic objects at the opposite boundaries of causal diamond (CD) produce identical scattering amplitudes.

### Fusion of the Two Approaches via a Generalization of the Space-Time Concept

The problem is that the two approaches to TGD seem to be mutually exclusive since the orbit of a particle like 3-surface defines 4-dimensional surface, which differs drastically from the topologically

trivial macroscopic space-time of General Relativity. The unification of these approaches forces a considerable generalization of the conventional space-time concept. First, the topologically trivial 3-space of General Relativity is replaced with a “topological condensate” containing matter as particle like 3-surfaces “glued” to the topologically trivial background 3-space by connected sum operation. Secondly, the assumption about connectedness of the 3-space is given up. Besides the “topological condensate” there could be “vapor phase” that is a “gas” of particle like 3-surfaces and string like objects (counterpart of the “baby universes” of GRT) and the non-conservation of energy in GRT corresponds to the transfer of energy between different sheets of the space-time and possible existence vapour phase.

. What one obtains is what I have christened as many-sheeted space-time (see **Fig.** <http://tgdtheory.fi/appfigures/manysheeted.jpg> or **Fig. ??** in the appendix of this book). One particular aspect is topological field quantization meaning that various classical fields assignable to a physical system correspond to space-time sheets representing the classical fields to that particular system. One can speak of the field body of a particular physical system. Field body consists of topological light rays, and electric and magnetic flux quanta. In Maxwell’s theory the physical system does not possess this kind of field identity. The notion of the magnetic body is one of the key players in TGD inspired theory of consciousness and quantum biology. The existence of monopole flux tubes requiring no current as a source of the magnetic field makes it possible to understand the existence of magnetic fields in cosmological and astrophysical scales.

This picture became more detailed with the advent of zero energy ontology (ZEO). The basic notion of ZEO is causal diamond (CD) identified as the Cartesian product of  $CP_2$  and of the intersection of future and past directed light-cones and having scale coming as an integer multiple of  $CP_2$  size is fundamental. CDs form a fractal hierarchy and zero energy states decompose to products of positive and negative energy parts assignable to the opposite boundaries of CD defining the ends of the space-time surface. The counterpart of zero energy state in positive energy ontology is the pair of initial and final states of a physical event, say particle reaction.

At space-time level ZEO means that 3-surfaces are pairs of space-like 3-surfaces at the opposite light-like boundaries of CD. Since the extremals of Kähler action connect these, one can say that by holography the basic dynamical objects are the space-time surface connecting these 3-surfaces and identifiable as analogs of Bohr orbits. This changes totally the vision about notions like self-organization: self-organization by quantum jumps does not take for a 3-D system but for the entire 4-D field pattern associated with it.

General Coordinate Invariance (GCI) allows to identify the basic dynamical objects as space-like 3-surfaces at the ends of space-time surface at boundaries of CD: this means that space-time surface is analogous to Bohr orbit. An alternative identification of the lines of generalized Feynman diagrams is as light-like 3-surfaces at which the signature of the induced metric changes from Minkowskian to Euclidian. Also the Euclidian 4-D regions can have a similar interpretation. The requirement that the two interpretations are equivalent, leads to a strong form of General Coordinate Invariance. The outcome is effective 2-dimensionality stating that the partonic 2-surfaces identified as intersections of the space-like ends of space-time surface and light-like wormhole throats are the fundamental objects. That only effective 2-dimensionality is in question is due to the effects caused by the failure of strict determinism of Kähler action. In finite length scale resolution these effects can be neglected below UV cutoff and above IR cutoff. One can also speak about a strong form of holography.

The understanding of the super symplectic invariance leads to the proposal that super symplectic algebra and other Kac-Moody type algebras labelled by non-negative multiples of basic conformal weights allow a hierarchy of symmetry breakings in which the analog of gauge symmetry breaks down to a genuine dynamical symmetry. This gives rise to fractal hierarchies of algebras and symmetry breakings. This breaking can occur also for ordinary conformal algebras if one restricts the conformal weights to be non-negative integers.

### 1.1.3 Basic Objections

Objections are the most powerful tool in theory building. The strongest objection against TGD is the observation that all classical gauge fields are expressible in terms of four embedding space coordinates only- essentially  $CP_2$  coordinates. The linear superposition of classical gauge fields taking place independently for all gauge fields is lost. This would be a catastrophe without many-

sheeted space-time. Instead of gauge fields, only the effects such as gauge forces are superposed. Particles topologically condense to several space-time sheets simultaneously and experience the sum of gauge forces. This transforms the weakness to extreme economy: in a typical unified theory the number of primary field variables is countered in hundreds if not thousands, now it is just four.

Second objection is that TGD space-time is quite too simple as compared to GRT space-time due to the embeddability to 8-D embedding space. One can also argue that Poincare invariant theory of gravitation cannot be consistent with General Relativity. The above interpretation makes it possible to understand the relationship to GRT space-time and how the Equivalence Principle (EP) follows from Poincare invariance of TGD. The interpretation of GRT space-time is as effective space-time obtained by replacing many-sheeted space-time with Minkowski space with effective metric determined as a sum of Minkowski metric and sum over the deviations of the induced metrics of the space-time sheets from Minkowski metric. Poincare invariance strongly suggests classical EP for the GRT limit in long length scales at least. One can also consider other kinds of limits such as the analog of GRT limit for Euclidian space-time regions assignable to elementary particles. In this case deformations of  $CP_2$  metric define a natural starting point and  $CP_2$  indeed defines a gravitational instanton with a very large cosmological constant in Einstein-Maxwell theory. Also gauge potentials of the standard model correspond classically to superpositions of induced gauge potentials over space-time sheets.

### Topological Field Quantization

Topological field quantization distinguishes between TGD based and more standard - say Maxwellian - notion of field. In Maxwell's fields created by separate systems superpose and one cannot tell which part of field comes from which system except theoretically. In TGD these fields correspond to different space-time sheets and only their effects on test particle superpose. Hence physical systems have well-defined field identifies - field bodies - in particular magnetic bodies.

The notion of magnetic body carrying dark matter with non-standard large value of Planck constant has become central concept in TGD inspired theory of consciousness and living matter, and by starting from various anomalies of biology one ends up to a rather detailed view about the role of magnetic body as intentional agent receiving sensory input from the biological body and controlling it using EEG and its various scaled up variants as a communication tool. Among other things this leads to models for cell membrane, nerve pulse, and EEG.

#### 1.1.4 Quantum TGD as Spinor Geometry of World of Classical Worlds

A turning point in the attempts to formulate a mathematical theory was reached after seven years from the birth of TGD. The great insight was "Do not quantize". The basic ingredients to the new approach have served as the basic philosophy for the attempt to construct Quantum TGD since then and have been the following ones.

#### World of Classical Worlds

The notion of WCW reduces the interacting quantum theory to a theory of free WCW spinor fields.

1. Quantum theory for extended particles is free(!), classical(!) field theory for a generalized Schrödinger amplitude identified as WCW spinor in the configuration space  $CH$  ("world of classical worlds", WCW) consisting of all possible 3-surfaces in  $H$ . "All possible" means that surfaces with arbitrary many disjoint components and with arbitrary internal topology and also singular surfaces topologically intermediate between two different manifold topologies are included.
2. 4-D general coordinate invariance forces holography and replaces the ill-defined path integral over all space-time surfaces with a discrete sum over 4-D analogs of Bohr orbits for particles identified as 3-surfaces. Holography means that basic objects are these analogs of Bohr orbits. Since there is no quantization at the level of WCW, one has an analog of wave mechanics with point-like particles replaced with 4-D Bohr orbits.

3. One must geometrize WCW as the space of Bohr orbits. In an infinite-dimensional situation the existence of geometry requires maximal symmetries already in the case of loop spaces. Physics is unique from its mathematical existence.

WCW is endowed with metric and spinor structure so that one can define various metric related differential operators, say Dirac operators, appearing in the field equations of the theory <sup>1</sup>

### Identification of Kähler function

The evolution of these basic ideas has been rather slow but has gradually led to a rather beautiful vision. One of the key problems has been the definition of Kähler function. Kähler function is Kähler action for a preferred extremal assignable to a given 3-surface but what this preferred extremal is? The obvious first guess was as absolute minimum of Kähler action but could not be proven to be right or wrong. One big step in the progress was boosted by the idea that TGD should reduce to almost topological QFT in which braids would replace 3-surfaces in finite measurement resolution, which could be inherent property of the theory itself and imply discretization at partonic 2-surfaces with discrete points carrying fermion number.

It took long time to realize that there is no discretization in 4-D sense - this would lead to difficulties with basic symmetries. Rather, the discretization occurs for the parameters characterizing co-dimension 2 objects representing the information about space-time surface so that they belong to some algebraic extension of rationals. These 2-surfaces - string world sheets and partonic 2-surfaces - are genuine physical objects rather than a computational approximation. Physics itself approximates itself, one might say! This is of course nothing but strong form of holography.

1. TGD as almost topological QFT vision suggests that Kähler action for preferred extremals reduces to Chern-Simons term assigned with space-like 3-surfaces at the ends of space-time (recall the notion of causal diamond (CD)) and with the light-like 3-surfaces at which the signature of the induced metric changes from Minkowskian to Euclidian. Minkowskian and Euclidian regions would give at wormhole throats the same contribution apart from coefficients and in Minkowskian regions the  $\sqrt{g_4}$  factor coming from metric would be imaginary so that one would obtain sum of real term identifiable as Kähler function and imaginary term identifiable as the ordinary Minkowskian action giving rise to interference effects and stationary phase approximation central in both classical and quantum field theory.

Imaginary contribution - the presence of which I realized only after 33 years of TGD - could also have topological interpretation as a Morse function. On physical side the emergence of Euclidian space-time regions is something completely new and leads to a dramatic modification of the ideas about black hole interior.

2. The way to achieve the reduction to Chern-Simons terms is simple. The vanishing of Coulomb contribution to Kähler action is required and is true for all known extremals if one makes a general ansatz about the form of classical conserved currents. The so called weak form of electric-magnetic duality defines a boundary condition reducing the resulting 3-D terms to Chern-Simons terms. In this way almost topological QFT results. But only "almost" since the Lagrange multiplier term forcing electric-magnetic duality implies that Chern-Simons action for preferred extremals depends on metric.

### WCW spinor fields

Classical WCW spinor fields are analogous to Schrödinger amplitudes and the construction of WCW Kähler geometry reduces to the second quantization of free spinor fields of  $H$ .

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<sup>1</sup>There are four kinds of Dirac operators in TGD. The geometrization of quantum theory requires Kähler metric definable either in terms of Kähler function identified as a the bosonic action for Euclidian space-time regions or as anti-commutators for WCW gamma matrices identified as conformal Noether super-charges associated with the second quantized modified Dirac action consisting of string world sheet term and possibly also modified Dirac action in Minkowskian space-time regions. These two possible definitions reflect a duality analogous to AdS/CFT duality.

1. The WCW metric is given by anticommutators of WCW gamma matrices which also have interpretation as supercharges assignable to the generators of WCW isometries and allowing expression as non-conserved Noether charges. Holography implies zero energy ontology (ZEO) meaning that zero energy states are superpositions of Bohr orbits connecting boundaries of causal diamond (CD). CDs form a fractal hierarchy and their space forming the spine of WCW is finite-dimensional and can be geometrized. The alternative interpretation is as a superposition of pairs of ordinary 3-D fermionic states assignable to the ends of the space-time surfaces.
2. There are several Dirac operators. WCW Dirac operator  $D_{WCW}$  appears in Super-symplectic gauge conditions analogous to Super Virasoro conditions. The algebraic variant of the  $H$  Dirac operator  $D_H$  appears in fermionic correlation functions: this is due to the fact that free fermions appearing as building bricks of WCW gamma matrices are modes of  $D_H$ . The modes of  $D_H$  define the ground states of super-symplectic representations. There is also the modified Dirac operator  $D_{X^4}$  acting on the induced spinors at space-time surfaces and it is dictated by symmetry one the action fixing the space-time surfaces as Bohr orbits is fixed.  $D_H$  is needed since it determines the expressions of WCW gamma matrices as Noether charges assignable to 3-surfaces at the ends of WCW.

### The role of modified Dirac action

1. By quantum classical correspondence, the construction of WCW spinor structure in sectors assignable to CDs reduces to the second quantization of the induced spinor fields of  $H$ . The basic action is so called modified Dirac action in which gamma matrices are replaced with the (modified) gamma matrices defined as contractions of the canonical momentum currents of the bosonic action defining the space-time surfaces with the embedding space gamma matrices. In this way one achieves super-conformal symmetry and conservation of fermionic currents among other things and a consistent Dirac equation.

Modified Dirac action is needed to define WCW gamma matrices as super charges assignable to WCW isometry generators identified as generators of symplectic transformations and by holography are needed only at the 3-surface at the boundaries of WCW. It is important to notice that the modified Dirac equation does not determine propagators since induced spinor fields are obtained from free second quantized spinor fields of  $H$ . This means enormous simplification and makes the theory calculable.

2. An important interpretational problem relates to the notion of the induced spinor connection. The presence of classical  $W$  boson fields is in conflict with the classical conservation of em charge since the coupling to classical  $W$  fields changes em charge.

One way out of the problem is the fact that the quantum averages of weak and gluon fields vanish unlike the quantum average of the em field. This leads to a rather precise understanding of electroweak symmetry breaking as being due the fact that color symmetries rotate space-time surfaces and also affect the induced weak fields.

One can also consider a stronger condition. If one requires that the spinor modes have well-defined em charge, one must assume that the modes in the generic situation are localized at 2-D surfaces - string world sheets or perhaps also partonic 2-surfaces - at which classical  $W$  boson fields vanish. Covariantly constant right handed neutrinos generating super-symmetries forms an exception. The vanishing of the  $Z^0$  field is possible for Kähler-Dirac action and should hold true at least above weak length scales. This implies that the string model in 4-D space-time becomes part of TGD. Without these conditions classical weak fields can vanish above weak scale only for the GRT limit of TGD for which gauge potentials are sums over those for space-time sheets.

The localization would simplify the mathematics enormously and one can solve exactly the Kähler-Dirac equation for the modes of the induced spinor field just like in super string models.

At the light-like 3-surfaces the signature of the induced metric changes from Euclidian to Minkowskian so that  $\sqrt{g_4}$  vanishes. One can pose the condition that the algebraic analog of

the massless Dirac equation is satisfied by the modes of the modified-Dirac action assignable to the Chern-Simons-Kähler action.

### 1.1.5 Construction of scattering amplitudes

#### Reduction of particle reactions to space-time topology

Particle reactions are identified as topology changes [A13, A16, A18]. For instance, the decay of a 3-surface to two 3-surfaces corresponds to the decay  $A \rightarrow B + C$ . Classically this corresponds to a path of WCW leading from 1-particle sector to 2-particle sector. At quantum level this corresponds to the dispersion of the generalized Schrödinger amplitude localized to 1-particle sector to two-particle sector. All coupling constants should result as predictions of the theory since no nonlinearities are introduced.

During years this naïve and very rough vision has of course developed a lot and is not anymore quite equivalent with the original insight. In particular, the space-time correlates of Feynman graphs have emerged from theory as Euclidian space-time regions and the strong form of General Coordinate Invariance has led to a rather detailed and in many respects un-expected visions. This picture forces to give up the idea about smooth space-time surfaces and replace space-time surface with a generalization of Feynman diagram in which vertices represent the failure of manifold property. I have also introduced the word “world of classical worlds” (WCW) instead of rather formal “configuration space”. I hope that “WCW” does not induce despair in the reader having tendency to think about the technicalities involved!

#### Construction of the counterparts of S-matrices

What does one mean with the counterpart of S-matrix in the TGD framework has been a long standing problem. The development of ZEO based quantum measurement theory has led to a rough overall view of the situation.

1. There are two kinds of state function reductions (SFRs). “Small” SFRs (SSFRs) following the TGD counterpart of a unitary time evolution defines a sequence of SFRs, which is analogous to a sequence of repeated quantum measurements associated with the Zeno effect. In wave mechanics nothing happens in these measurements. In quantum optics these measurements correspond to weak measurements. In TGD SSFR affects the zero energy state but leaves the 3-D state at the passive boundary of CD unaffected.
2. In TGD framework each SSFR is preceded by a counterpart of a unitary time evolution, which means dispersion in the space of CDs and unitary time evolution in fermionic degrees of freedom such that the passive boundary of CDs and 3-D states at it are unaffected but a superposition of CDs with varying active boundaries in the space of CDs is formed. In SSFR a localization in the space of CDs occurs such that the active is fixed. In a statistical sense the size of the CD increases and the increasing distance between the tips of the CD gives rise to the arrow of geometric time.
3. Also “big” SFRs (BSFRs) can occur and they correspond to ordinary SFRs. In BSFR the roles of the active and passive boundary are changed and this means that the arrow of time is changed. Big SFR occurs when the SSFR corresponds to a quantum measurement, which does not commute with the operators, which define the states at the passive boundary of CD as their eigenstates. This means a radical deviation from standard quantum measurement theory and has predictions in all scales.
4. One can assign the counterpart of S-matrix to the unitary time evolution between two subsequent SSFRs and also to the counterpart of S-matrix associated with BSFR. At least in the latter case the dimension of the state space can increase since at least BSFRs lead to the increase of the dimension of algebraic extension of rationals assignable to the space-time surface by  $M^8 - H$  duality. Unitarity is therefore replaced with isometry.
5. I have also considered the possibility that unitary S-matrix could be replaced in the fermionic degrees of freedom with Kähler metric of the state space satisfying analogs of unitarity conditions but it seems that this is un-necessary and also too outlandish an idea.



### The notion of M-matrix

1. The most ambitious dream is that zero energy states correspond to a complete solution basis for the Dirac operators associated with WCWs associated with the spaces of CDs with fixed passive boundary: this would define an S-matrix assignable to SFR. Also the analog of S-matrix for the localizations of the states to the active boundary assignable to the BSFR changing the state at the passive boundary of CD is needed.
2. If one allows entanglement between positive and energy parts of the zero energy state but assumes that the states at the passive boundary are fixed, one must introduce the counterpart of the density matrix, or rather its square root. This classical free field theory would dictate what I have called M-matrices defined between positive and negative energy parts of zero energy states which form orthonormal rows of what I call U-matrix as a matrix defined between zero energy states. A given M-matrix in turn would decompose to a product of a hermitian square root of density matrix and unitary S-matrix.
3. M-matrix would define time-like entanglement coefficients between positive and negative energy parts of zero energy states (all net quantum numbers vanish for them) and can be regarded as a hermitian square root of density matrix multiplied by a unitary S-matrix. Quantum theory would be in a well-defined sense a square root of thermodynamics. The orthogonality and hermiticity of the M-matrices commuting with S-matrix means that they span infinite-dimensional Lie algebras acting as symmetries of the S-matrix. Therefore quantum TGD would reduce to group theory in a well-defined sense.
4. In fact the Lie algebra of Hermitian M-matrices extends to Kac-Moody type algebra obtained by multiplying hermitian square roots of density matrices with powers of the S-matrix. Also the analog of Yangian algebra involving only non-negative powers of S-matrix is possible and would correspond to a hierarchy of CDs with the temporal distances between tips coming as integer multiples of the  $CP_2$  time.

The M-matrices associated with CDs are obtained by a discrete scaling from the minimal CD and characterized by integer  $n$  are naturally proportional to a representation matrix of scaling:  $S(n) = S^n$ , where  $S$  is unitary S-matrix associated with the minimal CD [K57]. This conforms with the idea about unitary time evolution as exponent of Hamiltonian discretized to integer power of  $S$  and represented as scaling with respect to the logarithm of the proper time distance between the tips of CD.

5. I have also considered the notion of U-matrix. U-matrix elements between M-matrices for various CDs are proportional to the inner products  $Tr[S^{-n_1} \circ H^i H^j \circ S^{n_2} \lambda]$ , where  $\lambda$  represents unitarily the discrete Lorentz boost relating the moduli of the active boundary of CD and  $H^i$  form an orthonormal basis of Hermitian square roots of density matrices.  $\circ$  tells that  $S$  acts at the active boundary of CD only. I have proposed a general representation for the U-matrix, reducing its construction to that of the S-matrix.

### 1.1.6 TGD as a generalized number theory

Quantum T(opological)D(ynamics) as a classical spinor geometry for infinite-dimensional configuration space (“world of classical worlds”, WCW), p-adic numbers and quantum TGD, and TGD inspired theory of consciousness, have been for last ten years the basic three strongly interacting threads in the tapestry of quantum TGD. The fourth thread deserves the name “TGD as a generalized number theory”. It involves three separate threads: the fusion of real and various p-adic physics to a single coherent whole by requiring number theoretic universality discussed already, the formulation of quantum TGD in terms of complexified counterparts of classical number fields, and the notion of infinite prime. Note that one can identify subrings such as hyper-quaternions and hyper-octonions as sub-spaces of complexified classical number fields with Minkowskian signature of the metric defined by the complexified inner product.

### The Threads in the Development of Quantum TGD

The development of TGD has involved several strongly interacting threads: physics as infinite-dimensional geometry; TGD as a generalized number theory, the hierarchy of Planck constants interpreted in terms of dark matter hierarchy, and TGD inspired theory of consciousness. In the following these threads are briefly described.

1. Quantum T(opological) G(eometro)D(ynamics) as a classical spinor geometry for infinite-dimensional WCW, p-adic numbers and quantum TGD, and TGD inspired theory of consciousness and of quantum biology have been for last decade of the second millenium the basic three strongly interacting threads in the tapestry of quantum TGD.
2. The discussions with Tony Smith initiated a fourth thread which deserves the name “TGD as a generalized number theory”. The basic observation was that classical number fields might allow a deeper formulation of quantum TGD. The work with Riemann hypothesis made time ripe for realization that the notion of infinite primes could provide, not only a reformulation, but a deep generalization of quantum TGD. This led to a thorough and rather fruitful revision of the basic views about what the final form and physical content of quantum TGD might be. Together with the vision about the fusion of p-adic and real physics to a larger coherent structure these sub-threads fused to the “physics as generalized number theory” thread.
3. A further thread emerged from the realization that by quantum classical correspondence TGD predicts an infinite hierarchy of macroscopic quantum systems with increasing sizes, that it is not at all clear whether standard quantum mechanics can accommodate this hierarchy, and that a dynamical quantized Planck constant might be necessary and strongly suggested by the failure of strict determinism for the fundamental variational principle. The identification of hierarchy of Planck constants labelling phases of dark matter would be natural. This also led to a solution of a long standing puzzle: what is the proper interpretation of the predicted fractal hierarchy of long ranged classical electro-weak and color gauge fields. Quantum classical correspondences allows only single answer: there is infinite hierarchy of p-adically scaled up variants of standard model physics and for each of them also dark hierarchy. Thus TGD Universe would be fractal in very abstract and deep sense.

The chronology based identification of the threads is quite natural but not logical and it is much more logical to see p-adic physics, the ideas related to classical number fields, and infinite primes as sub-threads of a thread which might be called “physics as a generalized number theory”. In the following I adopt this view. This reduces the number of threads to three corresponding to geometric, number theoretic and topological views of physics.

TGD forces the generalization of physics to a quantum theory of consciousness, and TGD as a generalized number theory vision leads naturally to the emergence of p-adic physics as physics of cognitive representations.

### Number theoretic vision very briefly

Number theoretic vision about quantum TGD involves notions like adelic physics,  $M^8 - H$  duality and number theoretic universality. A short review of the basic ideas that have developed during years is in order.

1. The physical interpretation of  $M^8$  is as an analog of momentum space and  $M^8 - H$  duality is analogous to momentum-position duality of ordinary wave mechanics.
2. Adelic physics means that all classical number fields, all p-adic number fields and their extensions induced by extensions of rationals and defining adeles, and also finite number fields are basic mathematical building bricks of physics.

The complexification of  $M^8$ , identified as complexified octonions, would provide a realization of this picture and  $M^8 - H$  duality would map the algebraic physics in  $M^8$  to the ordinary physics in  $M^4 \times CP_2$  described in terms of partial differential equations.

3. Negentropy Maximization Principle (NMP) states that the conscious information assignable with cognition representable measured in terms of p-adic negentropy increases in statistical sense.

NMP is mathematically completely analogous to the second law of thermodynamics and number theoretic evolution as an unavoidable statistical increase of the dimension of the algebraic extension of rationals characterizing a given space-time region implies it. There is no paradox involved: the p-adic negentropy measures the conscious information assignable to the entanglement of two systems regarded as a conscious entity whereas ordinary entropy measures the lack of information about the quantum state of either entangled system.

4. Number theoretical universality requires that space-time surfaces or at least their  $M^8 - H$  duals in  $M_c^8$  are defined for both reals and various p-adic number fields. This is true if they are defined by polynomials with integer coefficients as surfaces in  $M^8$  obeying number theoretic holography realized as associativity of the normal space of 4-D surface using as holographic data 3-surfaces at mass shells identified in terms of roots of a polynomial. A physically motivated additional condition is that the coefficients of the polynomials are smaller than their degrees.
5. Galois confinement is a key piece of the number theoretic vision. It states that the momenta of physical states are algebraic integers in the extensions of rationals assignable to the space-time region considered. These numbers are in general complex and are not consistent with particle in box quantization. The proposal is that physical states satisfy Galois confinement being thus Galois singlets and having therefore total momenta, whose components are ordinary integers, when momentum unit defined by the scale of causal diamond (CD) is used.
6. The notion of p-adic prime was introduced in p-adic mass calculations that started the developments around 1995. p-Adic length scale hypothesis states that p-adic primes near powers of 2 have a special physical role (as possibly also the powers of other small primes such as  $p = 3$ ).

The proposal is that p-adic primes correspond to ramified primes assignable to the extension and identified as divisors of the polynomial defined by the products of the root differences for the roots of the polynomial defining space-time space and having interpretation as values of, in general complex, virtual mass squared.

### **p-Adic TGD and fusion of real and p-adic physics to single coherent whole**

The p-adic thread emerged for roughly ten years ago as a dim hunch that p-adic numbers might be important for TGD. Experimentation with p-adic numbers led to the notion of canonical identification mapping reals to p-adics and vice versa. The breakthrough came with the successful p-adic mass calculations using p-adic thermodynamics for Super-Virasoro representations with the super-Kac-Moody algebra associated with a Lie-group containing standard model gauge group. Although the details of the calculations have varied from year to year, it was clear that p-adic physics reduces not only the ratio of proton and Planck mass, the great mystery number of physics, but all elementary particle mass scales, to number theory if one assumes that primes near prime powers of two are in a physically favored position. Why this is the case, became one of the key puzzles and led to a number of arguments with a common gist: evolution is present already at the elementary particle level and the primes allowed by the p-adic length scale hypothesis are the fittest ones.

It became very soon clear that p-adic topology is not something emerging in Planck length scale as often believed, but that there is an infinite hierarchy of p-adic physics characterized by p-adic length scales varying to even cosmological length scales. The idea about the connection of p-adics with cognition motivated already the first attempts to understand the role of the p-adics and inspired "Universe as Computer" vision but time was not ripe to develop this idea to anything concrete (p-adic numbers are however in a central role in TGD inspired theory of consciousness). It became however obvious that the p-adic length scale hierarchy somehow corresponds to a hierarchy of intelligences and that p-adic prime serves as a kind of intelligence quotient. Ironically, the almost obvious idea about p-adic regions as cognitive regions of space-time providing cognitive representations for real regions had to wait for almost a decade for the access into my consciousness.

In string model context one tries to reduce the physics to Planck scale. The price is the inability to say anything about physics in long length scales. In TGD p-adic physics takes care of this shortcoming by predicting the physics also in long length scales.

There were many interpretational and technical questions crying for a definite answer.

1. What is the relationship of p-adic non-determinism to the classical non-determinism of the basic field equations of TGD? Are the p-adic space-time region genuinely p-adic or does p-adic topology only serve as an effective topology? If p-adic physics is direct image of real physics, how the mapping relating them is constructed so that it respects various symmetries? Is the basic physics p-adic or real (also real TGD seems to be free of divergences) or both? If it is both, how should one glue the physics in different number field together to get *the* Physics? Should one perform p-adicization also at the level of the WCW? Certainly the p-adicization at the level of super-conformal representation is necessary for the p-adic mass calculations.
2. Perhaps the most basic and most irritating technical problem was how to precisely define p-adic definite integral which is a crucial element of any variational principle based formulation of the field equations. Here the frustration was not due to the lack of solution but due to the too large number of solutions to the problem, a clear symptom for the sad fact that clever inventions rather than real discoveries might be in question. Quite recently I however learned that the problem of making sense about p-adic integration has been for decades central problem in the frontier of mathematics and a lot of profound work has been done along same intuitive lines as I have proceeded in TGD framework. The basic idea is certainly the notion of algebraic continuation from the world of rationals belonging to the intersection of real world and various p-adic worlds.

Despite various uncertainties, the number of the applications of the poorly defined p-adic physics has grown steadily and the applications turned out to be relatively stable so that it was clear that the solution to these problems must exist. It became only gradually clear that the solution of the problems might require going down to a deeper level than that represented by reals and p-adics.

The key challenge is to fuse various p-adic physics and real physics to single larger structure. This has inspired a proposal for a generalization of the notion of number field by fusing real numbers and various p-adic number fields and their extensions along rationals and possible common algebraic numbers. This leads to a generalization of the notions of embedding space and space-time concept and one can speak about real and p-adic space-time sheets. One can talk about adelic space-time, embedding space, and WCW.

The corresponds of real 4-surfaces with the p-adic ones is induced by number theoretical discretization using points of 4-surfaces  $Y^4 \subset M_c^8$  identifiable as 8-momenta, whose components are assumed to be algebraic integers in an extension of rationals defined by the extension of rationals associated with a polynomial  $P$  with integer coefficients smaller than the degree of  $P$ . These points define a cognitive representation, which is universal in the sense that it exists also in the algebraic extensions of p-adic numbers. The points of the cognitive representations associated with the mass shells with mass squared values identified as roots of  $P$  are enough since  $M^8 - H$  duality can be used at both  $M^8$  and  $H$  sides and also in the p-adic context. The mass shells are special in that they allow for Minkowski coordinates very large cognitive representations unlike the interiors of the 4-surfaces determined by holography by using the data defined by the 3-surfaces at the mass shells. The higher the dimension of the algebraic extension associated with  $P$ , the better the accuracy of the cognitive representation.

Adelization providing number theoretical universality reduces to algebraic continuation for the amplitudes from this intersection of reality and various p-adicities - analogous to a back of a book - to various number fields. There are no problems with symmetries but canonical identification is needed: various group invariant of the amplitude are mapped by canonical identification to various p-adic number fields. This is nothing but a generalization of the mapping of the p-adic mass squared to its real counterpart in p-adic mass calculations.

This leads to surprisingly detailed predictions and far reaching conjectures. For instance, the number theoretic generalization of entropy concept allows negentropic entanglement central for the applications to living matter (see **Fig.** <http://tgdtheory.fi/appfigures/cat.jpg> or **Fig. ??** in the appendix of this book). One can also understand how preferred p-adic primes could

emerge as so called ramified primes of algebraic extension of rationals in question and characterizing string world sheets and partonic 2-surfaces. Preferred p-adic primes would be ramified primes for extensions for which the number of p-adic continuations of two-surfaces to space-time surfaces (imaginings) allowing also real continuation (realization of imagination) would be especially large. These ramifications would be winners in the fight for number theoretical survival. Also a generalization of p-adic length scale hypothesis emerges from NMP [K52].

The characteristic non-determinism of the p-adic differential equations suggests strongly that p-adic regions correspond to “mind stuff”, the regions of space-time where cognitive representations reside. This interpretation implies that p-adic physics is physics of cognition. Since Nature is probably a brilliant simulator of Nature, the natural idea is to study the p-adic physics of the cognitive representations to derive information about the real physics. This view encouraged by TGD inspired theory of consciousness clarifies difficult interpretational issues and provides a clear interpretation for the predictions of p-adic physics.

### Infinite primes

The discovery of the hierarchy of infinite primes and their correspondence with a hierarchy defined by a repeatedly second quantized arithmetic quantum field theory gave a further boost for the speculations about TGD as a generalized number theory.

After the realization that infinite primes can be mapped to polynomials possibly representable as surfaces geometrically, it was clear how TGD might be formulated as a generalized number theory with infinite primes forming the bridge between classical and quantum such that real numbers, p-adic numbers, and various generalizations of p-adics emerge dynamically from algebraic physics as various completions of the algebraic extensions of complexified quaternions and octonions. Complete algebraic, topological and dimensional democracy would characterize the theory.

The infinite primes at the first level of hierarchy, which represent analogs of bound states, can be mapped to irreducible polynomials, which in turn characterize the algebraic extensions of rationals defining a hierarchy of algebraic physics continuable to real and p-adic number fields. The products of infinite primes in turn define more general algebraic extensions of rationals. The interesting question concerns the physical interpretation of the higher levels in the hierarchy of infinite primes and integers mappable to polynomials of  $n > 1$  variables.

### 1.1.7 An explicit formula for $M^8 - H$ duality

$M^8 - H$  duality is a generalization of momentum-position duality relating the number theoretic and geometric views of physics in TGD and, despite that it still involves poorly understood aspects, it has become a fundamental building block of TGD. One has 4-D surfaces  $Y^4 \subset M_c^8$ , where  $M_c^8$  is complexified  $M^8$  having interpretation as an analog of complex momentum space and 4-D spacetime surfaces  $X^4 \subset H = M^4 \times CP_2$ .  $M_c^8$ , equivalently  $E_c^8$ , can be regarded as complexified octonions.  $M_c^8$  has a subspace  $M_c^4$  containing  $M^4$ .

**Comment:** One should be very cautious with the meaning of “complex”. Complexified octonions involve a complex imaginary unit  $i$  commuting with the octonionic imaginary units  $I_k$ .  $i$  is assumed to also appear as an imaginary unit also in complex algebraic numbers defined by the roots of polynomials  $P$  defining holographic data in  $M_c^8$ .

In the following  $M^8 - H$  duality and its twistor lift are discussed and an explicit formula for the dualities are deduced. Also possible variants of the duality are discussed.

### Holography in $H$

$X^4 \subset H$  satisfies holography and is analogous to the Bohr orbit of a particle identified as a 3-surface. The proposal is that holography reduces to a 4-D generalization of holomorphy so that  $X^4$  is a simultaneous zero of two functions of complex  $CP_2$  coordinates and of what I have called Hamilton-Jacobi coordinates of  $M^4$  with a generalized Kähler structure.

The simplest choice of the Hamilton-Jacobi coordinates is defined by the decomposition  $M^4 = M^2 \times E^2$ , where  $M^2$  is endowed with hypercomplex structure defined by light-like coordinates  $(u, v)$ , which are analogous to  $z$  and  $\bar{z}$ . Any analytic map  $u \rightarrow f(u)$  defines a new set

of light-like coordinates and corresponds to a solution of the massless d'Alembert equation in  $M^2$ .  $E^2$  has some complex coordinates with imaginary unit defined by  $i$ .

The conjecture is that also more general Hamilton-Jacobi structures for which the tangent space decomposition is local are possible. Therefore one would have  $M^4 = M^2(x) \times E^2(x)$ . These would correspond to non-equivalent complex and Kähler structures of  $M^4$  analogous to those possessed by 2-D Riemann surfaces and parametrized by moduli space.

### Number theoretic holography in $M_c^8$

$Y^4 \subset M_c^8$  satisfies number theoretic holography defining dynamics, which should reduce to associativity in some sense. The Euclidian complexified normal space  $N^4(y)$  at a given point  $y$  of  $Y^4$  is required to be associative, i.e. quaternionic. Besides this,  $N^4(i)$  contains a preferred complex Euclidian 2-D subspace  $Y^2(y)$ . Also the spaces  $Y^2(x)$  define an integrable distribution. I have assumed that  $Y^2(x)$  can depend on the point  $y$  of  $Y^4$ .

These assumptions imply that the normal space  $N(y)$  of  $Y^4$  can be parameterized by a point of  $CP_2 = SU(3)/U(2)$ . This distribution is always integrable unlike quaternionic tangent space distributions.  $M^8 - H$  duality assigns to the normal space  $N(y)$  a point of  $CP_2$ .  $M_c^4$  point  $y$  is mapped to a point  $x \in M^4 \subset M^4 \times CP_2$  defined by the real part of its inversion (conformal transformation): this formula involves effective Planck constant for dimensional reasons.

The 3-D holographic data, which partially fixes 4-surfaces  $Y^4$  is partially determined by a polynomial  $P$  with real integer coefficients smaller than the degree of  $P$ . The roots define mass squared values which are in general complex algebraic numbers and define complex analogs of mass shells in  $M_c^4 \subset M_c^8$ , which are analogs of hyperbolic spaces  $H^3$ . The 3-surfaces at these mass shells define 3-D holographic data continued to a surface  $Y^4$  by requiring that the normal space of  $Y^4$  is associative, i.e. quaternionic. These 3-surfaces are not completely fixed but an interesting conjecture is that they correspond to fundamental domains of tessellations of  $H^3$ .

What does the complexity of the mass shells mean? The simplest interpretation is that the space-like  $M^4$  coordinates (3-momentum components) are real whereas the time-like coordinate (energy) is complex and determined by the mass shell condition. One would have  $Re^2(E) - Im(E)^2 - p^2 = Re(m^2)$  and  $2Re(E)Im(E) = Im(m^2)$ . The condition for the real parts gives  $H^3$  when  $\sqrt{Re^2(E) - Im(E)^2}$  is taken as a time coordinate. The second condition allows to solve  $Im(E)$  in terms of  $Re(E)$  so that the first condition reduces to an equation of mass shell when  $\sqrt{(Re(E)^2 - Im(E)^2)}$ , expressed in terms of  $Re(E)$ , is taken as new energy coordinate  $E_{eff} = \sqrt{(Re(E)^2 - Im(E)^2)}$ . Is this deformation of  $H^3$  in imaginary time direction equivalent with a region of the hyperbolic 3-space  $H^3$ ?

One can look at the formula in more detail. Mass shell condition gives  $Re^2(E) - Im(E)^2 - p^2 = Re(m^2)$  and  $2Re(E)Im(E) = Im(m^2)$ . The condition for the real parts gives  $H^3$ , when  $\sqrt{Re^2(E) - Im(E)^2}$  is taken as an effective energy. The second condition allows to solve  $Im(E)$  in terms of  $Re(E)$  so that the first condition reduces to a dispersion relation for  $Re(E)^2$ .

$$Re(E)^2 = \frac{1}{2}(Re(m^2) - Im(m^2) + p^2)(1 \pm \sqrt{1 + \frac{2Im(m^2)^2}{(Re(m^2) - Im(m^2) + p^2)^2}}) \quad (1.1.1)$$

Only the positive root gives a non-tachyonic result for  $Re(m^2) - Im(m^2) > 0$ . For real roots with  $Im(m^2) = 0$  and at the high momentum limit the formula coincides with the standard formula. For  $Re(m^2) = Im(m^2)$  one obtains  $Re(E)^2 \rightarrow Im(m^2)/\sqrt{2}$  at the low momentum limit  $p^2 \rightarrow 0$ . Energy does not depend on momentum at all: the situation resembles that for plasma waves.

### Can one find an explicit formula for $M^8 - H$ duality?

The dream is an explicit formula for the  $M^8 - H$  duality mapping  $Y^4 \subset M_c^8$  to  $X^4 \subset H$ . This formula should be consistent with the assumption that the generalized holomorphy holds true for  $X^4$ .

The following proposal is a more detailed variant of the earlier proposal for which  $Y^4$  is determined by a map  $g$  of  $M_c^4 \rightarrow SU(3)_c \subset G_{2,c}$ , where  $G_{2,c}$  is the complexified automorphism group of octonions and  $SU(3)_c$  is interpreted as a complexified color group.

This map defines a trivial  $SU(3)_c$  gauge field. The real part of  $g$  however defines a non-trivial real color gauge field by the non-linearity of the non-abelian gauge field with respect to the gauge potential. The quadratic terms involving the imaginary part of the gauge potential give an additional condition to the real part in the complex situation and cancel it. If only the real part of  $g$  contributes, this contribution would be absent and the gauge field is non-vanishing.

How could the automorphism  $g(x) \subset SU(3) \subset G_2$  give rise to  $M^8 - H$  duality?

1. The interpretation is that  $g(y)$  at given point  $y$  of  $Y^4$  relates the normal space at  $y$  to a fixed quaternionic/associative normal space at point  $y_0$ , which corresponds is fixed by some subgroup  $U(2)_0 \subset SU(3)$ . The automorphism property of  $g$  guarantees that the normal space is quaternionic/associative at  $y$ . This simplifies the construction dramatically.
2. The quaternionic normal sub-space (which has Euclidian signature) contains a complex sub-space which corresponds to a point of sphere  $S^2 = SO(3)/O(2)$ , where  $SO(3)$  is the quaternionic automorphism group. The interpretation could be in terms of a selection of spin quantization axes. The local choice of the preferred complex plane would not be unique and is analogous to the possibility of having non-trivial Hamilton Jacobi structures in  $M^4$  characterized by the choice of  $M^2(x)$  and equivalently its normal subspace  $E^2(x)$ .

These two structures are independent apart from dependencies forced by the number theoretic dynamics. Hamilton-Jacobi structure means a selection of the quantization axis of spin and energy by fixing a distribution of light-like tangent vectors of  $M^4$  and the choice of the quaternionic normal sub-space fixes a choice of preferred quaternionic imaginary unit defining a quantization axis of the weak isospin.

3. The real part  $Re(g(y))$  defines a point of  $SU(3)$  and the bundle projection  $SU(3) \rightarrow CP_2$  in turn defines a point of  $CP_2 = SU(3)/U(2)$ . Hence one can assign to  $g$  a point of  $CP_2$  as  $M^8 - H$  duality requires and deduce an explicit formula for the point. This means a realization of the dream.
4. The construction requires a fixing of a quaternionic normal space  $N_0$  at  $y_0$  containing a preferred complex subspace at a single point of  $Y^4$  plus a selection of the function  $g$ . If  $M^4$  coordinates are possible for  $Y^4$ , the first guess is that  $g$  as a function of complexified  $M^4$  coordinates obeys generalized holomorphy with respect to complexified  $M^4$  coordinates in the same sense and in the case of  $X^4$ . This might guarantee that the  $M^8 - H$  image of  $Y^4$  satisfies the generalized holomorphy.
5. Also space-time surfaces  $X^4$  with  $M^4$  projection having a dimension smaller than 4 are allowed. I have proposed that they might correspond to singular cases for the above formula: a kind of blow-up would be involved. One can also consider a more general definition of  $Y^4$  allowing it to have a  $M^4$  projection with dimension smaller than 4 (say cosmic strings). Could one have implicit equations for the surface  $Y^4$  in terms of the complex coordinates of  $SU(3)_c$  and  $M^4$ ? Could this give for instance cosmic strings with a 2-D  $M^4$  projection and  $CP_2$  type extremals with 4-D  $CP_2$  projection and 1-D light-like  $M^4$  projection?

### What could the number theoretic holography mean physically?

What could be physical meaning of the number theoretic holography? The condition that has been assumed is that the  $CP_2$  coordinates at the mass shells of  $M_c^4 \subset M_c^8$  mapped to mass shells  $H^3$  of  $M^4 \subset M^4 \times CP_2$  are constant at the  $H^3$ . This is true if the  $g(y)$  defines the same  $CP_2$  point for a given component  $X_i^3$  of the 3-surface at a given mass shell.  $g$  is therefore fixed apart from a local  $U(2)$  transformation leaving the  $CP_2$  point invariant. A stronger condition would be that the  $CP_2$  point is the same for each component of  $X_i^3$  and even at each mass shell but this condition seems to be unnecessarily strong.

**Comment:** One can criticize this condition as too strong and one can consider giving up this condition. The motivation for this condition is that the number of algebraic points at the 3-surfaces associated with  $H^3$  explodes since the coordinates associated with normal directions vanish. Kind of cognitive explosion would be in question.

$SU(3)$  corresponds to a subgroup of  $G_2$  and one can wonder what the fixing of this subgroup could mean physically.  $G_2$  is 14-D and the coset space  $G_2/SU(3)$  is 6-D and a good guess is that

it is just the 6-D twistor space  $SU(3)/U(1) \times U(1)$  of  $CP_2$ : at least the isometries are the same. The fixing of the  $SU(3)$  subgroup means fixing of a  $CP_2$  twistor. Physically this means the fixing of the quantization axis of color isospin and hypercharge.

### Twistor lift of the holography

What is interesting is that by replacing  $SU(3)$  with  $G_2$ , one obtains an explicit formula from the generalization of  $M^8 - H$  duality to that for the twistorial lift of TGD!

One can also consider a twistorial generalization of the above proposal for the number theoretic holography by allowing local  $G_2$  automorphisms interpreted as local choices of the color quantization axis.  $G_2$  elements would be fixed apart from a local  $SU(3)$  transformation at the components of 3-surfaces at mass shells. The choice of the color quantization axes for a connected 3-surface at a given mass shell would be the same everywhere. This choice is indeed very natural physically since 3-surface corresponds to a particle.

Is this proposal consistent with the boundary condition of the number theoretical holography mean in the case of 4-surfaces in  $M_c^8$  and  $M^4 \times CP_2$ ?

1. The selection of  $SU(3) \subset G_2$  for ordinary  $M^8 - H$  duality means that the  $G_{2,c}$  gauge field vanishes everywhere and the choice of color quantization axis is the same at all points of the 4-surface. The fixing of the  $CP_2$  point to be constant at  $H^3$  implies that the color gauge field at  $H^3 \subset M_c^8$  and its image  $H^3 \subset H$  vanish. One would have color confinement at the mass shells  $H_i^3$ , where the observations are made. Is this condition too strong?
2. The constancy of the  $G_2$  element at mass shells makes sense physically and means a fixed color quantization axis. The selection of a fixed  $SU(3) \subset G_2$  for entire space-time surface is in conflict with the non-constancy of  $G_2$  element unless  $G_2$  element differs at different points of 4-surface only by a multiplication of a local  $SU(3)_0$  element, that is local  $SU(3)$  transformation. This kind of variation of the  $G_2$  element would mean a fixed color group but varying choice of color quantization axis.
3. Could one consider the possibility that the local  $G_{2,c}$  element is free and defines the twistor lift of  $M^8 - H$  duality as something more fundamental than the ordinary  $M^8 - H$  duality based on  $SU(3)_c$ . This duality would make sense only at the mass shells so that only the spaces  $H^3 \times CP_2$  assignable to mass shells would make sense physically? In the interior  $CP_2$  would be replaced with the twistor space  $SU(3)/U(1) \times U(1)$ . Color gauge fields would be non-vanishing at the mass shells but outside the mass shells one would have  $G_2$  gauge fields.

There is also a physical objection against the  $G_2$  option. The 14-D Lie algebra representation of  $G_2$  acts on the imaginary octonions which decompose with respect to the color group to  $1 \oplus 3 \oplus \bar{3}$ . The automorphism property requires that 1 can be transformed to 3 or  $\bar{3}$  to themselves: this requires that the decomposition contains  $3 \oplus \bar{3}$ . Furthermore, it must be possible to transform 3 and  $\bar{3}$  to themselves, which requires the presence of 8. This leaves only the decomposition  $8 \oplus 3 \oplus \bar{3}$ .  $G_2$  gluons would both color octet and triplets. In the TDG framework the only conceivable interpretation would be in terms of ordinary gluons and leptoquark-like gluons. This does not fit with the basic vision of TGD.

The choice of twistor as a selection of quantization axes should make sense also in the  $M^4$  degrees of freedom.  $M^4$  twistor corresponds to a choice of light-like direction at a given point of  $M^4$ . The spatial component of the light-like vector fixes the spin quantization axis. Its choice together with the light-likeness fixes the time direction and therefore the rest system and energy quantization axis. Light-like vector fixes also the choice of  $M^2$  and of  $E^2$  as its orthogonal complement. Therefore the fixing of  $M^4$  twistor as a point of  $SU(4)/SU(3) \times U(1)$  corresponds to a choice of the spin quantization axis and the time-like axis defining the rest system in which the energy is measured. This choice would naturally correspond to the Hamilton-Jacobi structure fixing the decompositions  $M^2(x) \times E^2(x)$ . At a given mass shell the choice of the quantization axis would be constant for a given  $X_i^3$ .



### 1.1.8 Hierarchy of Planck Constants and Dark Matter Hierarchy

By quantum classical correspondence space-time sheets can be identified as quantum coherence regions. Hence the fact that they have all possible size scales more or less unavoidably implies that Planck constant must be quantized and have arbitrarily large values. If one accepts this then also the idea about dark matter as a macroscopic quantum phase characterized by an arbitrarily large value of Planck constant emerges naturally as does also the interpretation for the long ranged classical electro-weak and color fields predicted by TGD. Rather seldom the evolution of ideas follows simple linear logic, and this was the case also now. In any case, this vision represents the fifth, relatively new thread in the evolution of TGD and the ideas involved are still evolving.

#### Dark Matter as Large $\hbar$ Phases

D. Da Rocha and Laurent Nottale [E1] have proposed that Schrödinger equation with Planck constant  $\hbar$  replaced with what might be called gravitational Planck constant  $\hbar_{gr} = \frac{GmM}{v_0}$  ( $\hbar = c = 1$ ).  $v_0$  is a velocity parameter having the value  $v_0 = 144.7 \pm .7$  km/s giving  $v_0/c = 4.6 \times 10^{-4}$ . This is rather near to the peak orbital velocity of stars in galactic halos. Also subharmonics and harmonics of  $v_0$  seem to appear. The support for the hypothesis coming from empirical data is impressive.

Nottale and Da Rocha believe that their Schrödinger equation results from a fractal hydrodynamics. Many-sheeted space-time however suggests that astrophysical systems are at some levels of the hierarchy of space-time sheets macroscopic quantum systems. The space-time sheets in question would carry dark matter.

Nottale's hypothesis would predict a gigantic value of  $\hbar_{gr}$ . Equivalence Principle and the independence of gravitational Compton length on mass  $m$  implies however that one can restrict the values of mass  $m$  to masses of microscopic objects so that  $\hbar_{gr}$  would be much smaller. Large  $\hbar_{gr}$  could provide a solution of the black hole collapse (IR catastrophe) problem encountered at the classical level. The resolution of the problem inspired by TGD inspired theory of living matter is that it is the dark matter at larger space-time sheets which is quantum coherent in the required time scale [K87].

It is natural to assign the values of Planck constants postulated by Nottale to the space-time sheets mediating gravitational interaction and identifiable as magnetic flux tubes (quanta) possibly carrying monopole flux and identifiable as remnants of cosmic string phase of primordial cosmology. The magnetic energy of these flux quanta would correspond to dark energy and magnetic tension would give rise to negative "pressure" forcing accelerate cosmological expansion. This leads to a rather detailed vision about the evolution of stars and galaxies identified as bubbles of ordinary and dark matter inside magnetic flux tubes identifiable as dark energy.

Certain experimental findings suggest the identification  $\hbar_{eff} = n \times \hbar_{gr}$ . The large value of  $\hbar_{gr}$  can be seen as a way to reduce the string tension of fermionic strings so that gravitational (in fact all!) bound states can be described in terms of strings connecting the partonic 2-surfaces defining particles (analogous to AdS/CFT description). The values  $\hbar_{eff}/\hbar = n$  can be interpreted in terms of a hierarchy of breakings of super-conformal symmetry in which the super-conformal generators act as gauge symmetries only for a sub-algebras with conformal weights coming as multiples of  $n$ . Macroscopic quantum coherence in astrophysical scales is implied. If also Kähler-Dirac action is present, part of the interior degrees of freedom associated with the Kähler-Dirac part of conformal algebra become physical. A possible is that fermionic oscillator operators generate super-symmetries and sparticles correspond almost by definition to dark matter with  $\hbar_{eff}/\hbar = n > 1$ . One implication would be that at least part if not all gravitons would be dark and be observed only through their decays to ordinary high frequency graviton ( $E = \hbar f_{high} = \hbar_{eff} f_{low}$ ) of bunch of  $n$  low energy gravitons.

#### Hierarchy of Planck Constants from the Anomalies of Neuroscience and Biology

The quantal ELF effects of ELF em fields on vertebrate brain have been known since seventies. ELF em fields at frequencies identifiable as cyclotron frequencies in magnetic field whose intensity is about 2/5 times that of Earth for biologically important ions have physiological effects and affect also behavior. What is intriguing that the effects are found only in vertebrates (to my best knowledge). The energies for the photons of ELF em fields are extremely low - about  $10^{-10}$  times

lower than thermal energy at physiological temperatures- so that quantal effects are impossible in the framework of standard quantum theory. The values of Planck constant would be in these situations large but not gigantic.

This inspired the hypothesis that these photons correspond to so large a value of Planck constant that the energy of photons is above the thermal energy. The proposed interpretation was as dark photons and the general hypothesis was that dark matter corresponds to ordinary matter with non-standard value of Planck constant. If only particles with the same value of Planck constant can appear in the same vertex of Feynman diagram, the phases with different value of Planck constant are dark relative to each other. The phase transitions changing Planck constant can however make possible interactions between phases with different Planck constant but these interactions do not manifest themselves in particle physics. Also the interactions mediated by classical fields should be possible. Dark matter would not be so dark as we have used to believe.

The hypothesis  $h_{eff} = h_{gr}$  - at least for microscopic particles - implies that cyclotron energies of charged particles do not depend on the mass of the particle and their spectrum is thus universal although corresponding frequencies depend on mass. In bio-applications this spectrum would correspond to the energy spectrum of bio-photons assumed to result from dark photons by  $h_{eff}$  reducing phase transition and the energies of bio-photons would be in visible and UV range associated with the excitations of bio-molecules.

Also the anomalies of biology (see for instance [K71, K72, K69] ) support the view that dark matter might be a key player in living matter.

### Dark Matter as a Source of Long Ranged Weak and Color Fields

Long ranged classical electro-weak and color gauge fields are unavoidable in TGD framework. The smallness of the parity breaking effects in hadronic, nuclear, and atomic length scales does not however seem to allow long ranged electro-weak gauge fields. The problem disappears if long range classical electro-weak gauge fields are identified as space-time correlates for massless gauge fields created by dark matter. Also scaled up variants of ordinary electro-weak particle spectra are possible. The identification explains chiral selection in living matter and unbroken  $U(2)_{ew}$  invariance and free color in bio length scales become characteristics of living matter and of bio-chemistry and bio-nuclear physics.

The recent view about the solutions of Kähler- Dirac action assumes that the modes have a well-defined em charge and this implies that localization of the modes to 2-D surfaces (right-handed neutrino is an exception). Classical  $W$  boson fields vanish at these surfaces and also classical  $Z^0$  field can vanish. The latter would guarantee the absence of large parity breaking effects above intermediate boson scale scaling like  $h_{eff}$ .

### 1.1.9 Twistors in TGD and connection with Veneziano duality

The twistorialization of TGD has two aspects. The attempt to generalize twistor Grassmannian approach emerged first. It was however followed by the realization that also the twistor lift of TGD at classical space-time level is needed. It turned out that the progress in the understanding of the classical twistor lift has been much faster - probably this is due to my rather limited technical QFT skills.

#### Twistor lift at space-time level

8-dimensional generalization of ordinary twistors is highly attractive approach to TGD [K101]. The reason is that  $M^4$  and  $CP_2$  are completely exceptional in the sense that they are the only 4-D manifolds allowing twistor space with Kähler structure [A12]. The twistor space of  $M^4 \times CP_2$  is Cartesian product of those of  $M^4$  and  $CP_2$ . The obvious idea is that space-time surfaces allowing twistor structure if they are orientable are representable as surfaces in  $H$  such that the properly induced twistor structure co-incides with the twistor structure defined by the induced metric.

In fact, it is enough to generalize the induction of spinor structure to that of twistor structure so that the induced twistor structure need not be identical with the ordinary twistor structure possibly assignable to the space-time surface. The induction procedure reduces to a dimensional reduction of 6-D Kähler action giving rise to 6-D surfaces having bundle structure with twistor

sphere as fiber and space-time as base. The twistor sphere of this bundle is imbedded as sphere in the product of twistor spheres of twistor spaces of  $M^4$  and  $CP_2$ .

This condition would define the dynamics, and the original conjecture was that this dynamics is equivalent with the identification of space-time surfaces as preferred extremals of Kähler action. The dynamics of space-time surfaces would be lifted to the dynamics of twistor spaces, which are sphere bundles over space-time surfaces. What is remarkable that the powerful machinery of complex analysis becomes available.

It however turned out that twistor lift of TGD is much more than a mere technical tool. First of all, the dimensionally reduction of 6-D Kähler action contained besides 4-D Kähler action also a volume term having interpretation in terms of cosmological constant. This need not bring anything new, since all known extremals of Kähler action with non-vanishing induced Kähler form are minimal surfaces. There is however a large number of embeddings of twistor sphere of space-time surface to the product of twistor spheres. Cosmological constant has spectrum and depends on length scale, and the proposal is that coupling constant reduces to that for cosmological constant playing the role of cutoff length. That cosmological constant could transform from a mere nuisance to a key element of fundamental physics was something totally new and unexpected.

1. The twistor lift of TGD at space-time level forces to replace 4-D Kähler action with 6-D dimensionally reduced Kähler action for 6-D surface in the 12-D Cartesian product of 6-D twistor spaces of  $M^4$  and  $CP_2$ . The 6-D surface has bundle structure with twistor sphere as fiber and space-time surface as base.

Twistor structure is obtained by inducing the twistor structure of 12-D twistor space using dimensional reduction. The dimensionally reduced 6-D Kähler action is sum of 4-D Kähler action and volume term having interpretation in terms of a dynamical cosmological constant depending on the size scale of space-time surface (or of causal diamond CD in zero energy ontology (ZEO)) and determined by the representation of twistor sphere of space-time surface in the Cartesian product of the twistor spheres of  $M^4$  and  $CP_2$ .

2. The preferred extremal property as a representation of quantum criticality would naturally correspond to minimal surface property meaning that the space-time surface is separately an extremal of both Kähler action and volume term almost everywhere so that there is no coupling between them. This is the case for all known extremals of Kähler action with non-vanishing induced Kähler form.

Minimal surface property could however fail at 2-D string world sheets, their boundaries and perhaps also at partonic 2-surfaces. The failure is realized in minimal sense if the 3-surface has 1-D edges/folds (strings) and 4-surface 2-D edges/folds (string world sheets) at which some partial derivatives of the embedding space coordinates are discontinuous but canonical momentum densities for the entire action are continuous.

There would be no flow of canonical momentum between interior and string world sheet and minimal surface equations would be satisfied for the string world sheet, whose 4-D counterpart in twistor bundle is determined by the analog of 4-D Kähler action. These conditions allow the transfer of canonical momenta between Kähler- and volume degrees of freedom at string world sheets. These no-flow conditions could hold true at least asymptotically (near the boundaries of CD).

$M^8 - H$  duality suggests that string world sheets (partonic 2-surfaces) correspond to images of complex 2-sub-manifolds of  $M^8$  (having tangent (normal) space which is complex 2-plane of octonionic  $M^8$ ).

3. Cosmological constant would depend on p-adic length scales and one ends up to a concrete model for the evolution of cosmological constant as a function of p-adic length scale and other number theoretic parameters (such as Planck constant as the order of Galois group): this conforms with the earlier picture.

Inflation is replaced with its TGD counterpart in which the thickening of cosmic strings to flux tubes leads to a transformation of Kähler magnetic energy to ordinary and dark matter. Since the increase of volume increases volume energy, this leads rapidly to energy minimum at some flux tube thickness. The reduction of cosmological constant by a phase transition

however leads to a new expansion phase. These jerks would replace smooth cosmic expansion of GRT. The discrete coupling constant evolution predicted by the number theoretical vision could be understood as being induced by that of cosmological constant taking the role of cutoff parameter in QFT picture [L46].

### Twistor lift at the level of scattering amplitudes and connection with Veneziano duality

The classical part of twistor lift of TGD is rather well-understood. Concerning the twistorialization at the level of scattering amplitudes the situation is much more difficult conceptually - I already mentioned my limited QFT skills.

1. From the classical picture described above it is clear that one should construct the 8-D twistorial counterpart of theory involving space-time surfaces, string world sheets and their boundaries, plus partonic 2-surfaces and that this should lead to concrete expressions for the scattering amplitudes.

The light-like boundaries of string world sheets as carriers of fermion numbers would correspond to twistors as they appear in twistor Grassmann approach and define the analog for the massless sector of string theories. The attempts to understand twistorialization have been restricted to this sector.

2. The beautiful basic prediction would be that particles massless in 8-D sense can be massive in 4-D sense. Also the infrared cutoff problematic in twistor approach emerges naturally and reduces basically to the dynamical cosmological constant provided by classical twistor lift.

One can assign 4-momentum both to the spinor harmonics of the embedding space representing ground states of super-conformal representations and to light-like boundaries of string world sheets at the orbits of partonic 2-surfaces. The two four-momenta should be identical by quantum classical correspondence: this could be seen as a concretization of Equivalence Principle. Also a connection with string model emerges.

3. As far as symmetries are considered, the picture looks rather clear. Ordinary twistor Grassmannian approach boils down to the construction of scattering amplitudes in terms of Yangian invariants for conformal group of  $M^4$ . Therefore a generalization of super-symplectic symmetries to their Yangian counterpart seems necessary. These symmetries would be gigantic but how to deduce their implications?
4. The notion of positive Grassmannian is central in the twistor approach to the scattering amplitudes in  $calN = 4$  SUSYs. TGD provides a possible generalization and number theoretic interpretation of this notion. TGD generalizes the observation that scattering amplitudes in twistor Grassmann approach correspond to representations for permutations. Since 2-vertex is the only fermionic vertex in TGD, OZI rules for fermions generalizes, and scattering amplitudes are representations for braidings.

Braid interpretation encourages the conjecture that non-planar diagrams can be reduced to ordinary ones by a procedure analogous to the construction of braid (knot) invariants by gradual un-braiding (un-knotting).

This is however not the only vision about a solution of non-planarity. Quantum criticality provides different view leading to a totally unexpected connection with string models, actually with the Veneziano duality, which was the starting point of dual resonance model in turn leading via dual resonance models to super string models.

1. Quantum criticality in TGD framework means that coupling constant evolution is discrete in the sense that coupling constants are piecewise constant functions of length scale replaced by dynamical cosmological constant. Loop corrections would vanish identically and the recursion formulas for the scattering amplitudes (allowing only planar diagrams) deduced in twistor Grassmann would involve no loop corrections. In particular, cuts would be replaced by sequences of poles mimicking them like sequences of point charge mimic line charges. In momentum discretization this picture follows automatically.

2. This would make sense in finite measurement resolution realized in number theoretical vision by number-theoretic discretization of the space-time surface (cognitive representation) as points with coordinates in the extension of rationals defining the adèle [L38]. Similar discretization would take place for momenta. Loops would vanish at the level of discretization but what would happen at the possibly existing continuum limit: does the sequence of poles integrate to cuts? Or is representation as sum of resonances something much deeper?
3. Maybe it is! The basic idea of behind the original Veneziano amplitudes (see <http://tinyurl.com/yyhwvqb>) was Veneziano duality. This 4-particle amplitude was generalized by Yoshiro Nambu, Holger-Bek Nielsen, and Leonard Susskind to N-particle amplitude (see <http://tinyurl.com/yyvks7as>) based on string picture, and the resulting model was called dual resonance model. The model was forgotten as QCD emerged. Later came superstring models and led to M-theory. Now it has become clear that something went wrong, and it seems that one must return to the roots. Could the return to the roots mean a careful reconsideration of the dual resonance model?

4. Recall that Veneziano duality (1968) was deduced by assuming that scattering amplitude can be described as sum over s-channel resonances or t-channel Regge exchanges and Veneziano duality stated that hadronic scattering amplitudes have representation as sums over s- or t-channel resonance poles identified as excitations of strings. The sum over exchanges defined by t-channel resonances indeed reduces at larger values of  $s$  to Regge form.

The resonances had zero width, which was not consistent with unitarity. Further, there were no counterparts for the *sum* of s-, t-, and u-channel diagrams with continuous cuts in the kinematical regions encountered in QFT approach. What puts bells ringing is the u-channel diagrams would be non-planar and non-planarity is the problem of twistor Grassmann approach.

5. Veneziano duality is true only for s- and t- channels but not been s- and u-channel. Stringy description makes t-channel and s-channel pictures equivalent. Could it be that in fundamental description u-channels diagrams cannot be distinguished from s-channel diagrams or t-channel diagrams? Could the stringy representation of the scattering diagrams make u-channel twist somehow trivial if handles of string world sheet representing stringy loops in turn representing the analog of non-planarity of Feynman diagrams are absent? The permutation of external momenta for tree diagram in absence of loops in planar representation would be a twist of  $\pi$  in the representation of planar diagram as string world sheet and would not change the topology of the string world sheet and would not involve non-trivial world sheet topology.

For string world sheets loops would correspond to handles. The presence of handle would give an edge with a loop at the level of 3-surface (self energy correction in QFT). Handles are not allowed if the induced metric for the string world sheet has Minkowskian signature. If the stringy counterparts of loops are absent, also the loops in scattering amplitudes should be absent.

This argument applies only inside the Minkowskian space-time regions. If string world sheets are present also in Euclidian regions, they might have handles and loop corrections could emerge in this manner. In TGD framework strings (string world sheets) are identified to 1-D edges/folds of 3-surface at which minimal surface property and topological QFT property fails (minimal surfaces as calibrations). Could the interpretation of edge/fold as discontinuity of some partial derivatives exclude loopy edges: perhaps the branching points would be too singular?

A reduction to a sum over s-channel resonances is what the vanishing of loops would suggest. Could the presence of string world sheets make possible the vanishing of continuous cuts even at the continuum limit so that continuum cuts would emerge only in the approximation as the density of resonances is high enough?

The replacement of continuous cut with a sum of *infinitely* narrow resonances is certainly an approximation. Could it be that the stringy representation as a sum of resonances with *finite* width is an essential aspect of quantum physics allowing to get rid of infinities necessarily accompanying loops? Consider now the arguments against this idea.

1. How to get rid of the problems with unitarity caused by the zero width of resonances? Could *finite* resonance widths make unitarity possible? Ordinary twistor Grassmannian approach predicts that the virtual momenta are light-like but complex: obviously, the imaginary part of the energy in rest frame would have interpretation as resonance width.

In TGD framework this generalizes for 8-D momenta. By quantum-classical correspondence (QCC) the classical Noether charges are equal to the eigenvalues of the fermionic charges in Cartan algebra (maximal set of mutually commuting observables) and classical TGD indeed predicts complex momenta (Kähler coupling strength is naturally complex). QCC thus supports this proposal.

2. Sum over resonances/exchanges picture is in conflict with QFT picture about scattering of particles. Could *finite* resonance widths due to the complex momenta give rise to the QFT type scattering amplitudes as one develops the amplitudes in Taylor series with respect to the resonance width? Unitarity condition indeed gives the first estimate for the resonance width.

QFT amplitudes should emerge in an approximation obtained by replacing the discrete set of finite width resonances with a cut as the distance between poles is shorter than the resolution for mass squared.

In superstring models string tension has single very large value and one cannot obtain QFT type behavior at low energies (for instance, scattering amplitudes in hadronic string model are concentrated in forward direction). TGD however predicts an entire hierarchy of p-adic length scales with varying string tension. The hierarchy of mass scales corresponding roughly to the lengths and thickness of magnetic flux tubes as thickened cosmic strings and characterized by the value of cosmological constant predicted by twistor lift of TGD. Could this give rise to continuous QFT type cuts at the limit when measurement resolution cannot distinguish between resonances?

The dominating term in the sum over sums of resonances in  $t$ -channel gives near forward direction approximately the lowest mass resonance for strings with the smallest string tension. This gives the behavior  $1/(t - m_{min}^2)$ , where  $m_{min}$  corresponds to the longest mass scale involved (the largest space-time sheet involved), approximating the  $1/t$ -behavior of massless theories. This also brings in IR cutoff, the lack of which is a problem of gauge theories. This should give rise to continuous QFT type cuts at the limit when measurement resolution cannot distinguish between resonances.

## 1.2 Bird's Eye of View about the Topics of "TGD Inspired Theory of Consciousness: Part III"

The overall view of the topics of the book is given in the first part of the book and only the organization of the contents of "TGD Inspired Theory of Consciousness: Part III" is represented.

This book is devoted to remote mental interactions. The theoretical motivation for taking remote mental interactions seriously is that exactly the same mechanisms which are involved with the interaction between magnetic body and biological body apply also to remote mental interactions in TGD Universe.

One could also understand why these phenomena are rare: a kind of immune system making it impossible for foreign magnetic bodies to control and communicate with the biological body possessed by a particular magnetic body would be a highly probable (but perhaps not unavoidable) outcome of evolutionary process. A chapter describing a general model is followed by several chapters devoted to possible applications. These chapters have appeared also as articles in the journal devoted to remote mental interactions edited by Lian Sidoroff.

## 1.3 Sources

The eight online books about TGD [K107, K102, K79, K60, K17, K58, K41, K90] and nine online books about TGD inspired theory of consciousness and quantum biology [K99, K13, K68, K11,

K38, K46, K49, K89, K97] are warmly recommended for the reader willing to get overall view about what is involved.

My homepage (<http://tinyurl.com/ybv8dt4n>) contains a lot of material about TGD. In particular, a TGD glossary at <http://tinyurl.com/yd6j3o7>.

I have published articles about TGD and its applications to consciousness and living matter in *Journal of Non-Locality* (<http://tinyurl.com/ycyrxj4o> founded by Lian Sidorov and in *Prespacetime Journal* (<http://tinyurl.com/ycvktjhn>), *Journal of Consciousness Research and Exploration* (<http://tinyurl.com/yba4f672>), and *DNA Decipher Journal* (<http://tinyurl.com/y9z52khg>), all of them founded by Huping Hu. One can find the list about the articles published at <http://tinyurl.com/ybv8dt4n>. I am grateful for these far-sighted people for providing a communication channel, whose importance one cannot overestimate.

### 1.3.1 Quantum Model of Paranormal Phenomena

The general quantum model for bio-systems leads to a model for bio-control which applies to a very wide variety of hard-to-understand bio-chemical phenomena such as molecular recognition mechanisms, water memory, and homeopathy and leads to a generalization of genetic code explaining the mystery of introns. The same model generalizes to a model of paranormal phenomena such as psychokinesis, remote sensing, remote healing, telepathy, communications with deceased, and instrumental transcommunications. The basic difference is that magnetic body receives information and controls “foreign” biological (or even magnetic) body or “dead” matter system.

The basic notions of the model are magnetic body as an intentional agent controlling biological body and receiving data from living body or even “dead” matter system with massless extremals (MEs) mediating these communications, zero energy ontology and the related notion of causal diamond (CD) serving as an embedding space correlate of self and assigning to elementary particles fundamental macroscopic time and length scales as those of CD, the hierarchy of Planck constants making possible macroscopic quantum phases and zoom-ups of quantum systems, and the vision about living matter as something residing in the intersection of real and p-adic worlds and the closely related notion of negentropic entanglement crucial for the functioning of living matter and conscious intelligence in TGD Universe.

Negentropic entanglement, which can be both space-like and time-like in zero energy ontology, makes possible quantum superposition of macroscopically different configurations of the target system correlated with the states of operator system. The operator should be able to achieve the negentropic entanglement and intentionally increase the amplitude of the desired outcome in this superposition. Negentropic entanglement need not involve binding energy and I have proposed this as a deeper level explanation for the nebulous notion of high energy phosphate bond crucial for metabolism in living matter. Quite generally, negentropic entanglement would make possible for the operator to transfer metabolic energy and momentum to the target. The hierarchy of values of Planck constant would make possible this process in long time and length scales.

1. Magnetic mirrors (ME-magnetic flux tube pairs) connecting the sender and receiver make possible a universal mechanism for the transfer of intent and action. The pair of flux tubes forms a kind of sensory-motor loop. In biology the fundamental realization could be by a pair of flux sheets going through the strands of DNA with passive strand sending sensory data to the magnetic body and active strand receiving control commands leading to various forms of gene expression. MEs are ideal for the transfer of both classical information and momentum.
2. p-Adic MEs represent the transfer of a mere intent and real MEs represent a transfer of action. p-Adic ME can be transformed to real ME either by receiver or some higher level magnetic self. This makes sense only in the intersection of real and p-adic worlds.
3. The transfer of intent gives rise to mechanism of remote interaction which can act both endo- and exogenously. Magnetic mirrors characterized by their fundamental frequencies make possible bridges between sender and receiver (say healer and healee) and allow a resonant interaction in which healer can initiate various control commands acting as 4-dimensional templates represented as holograms. Also smaller MEs can be send along the MEs serving as bridges (this is like throwing balls with light velocity!).

4. The ME-magnetic flux tube pair connecting sender and receiver can act as a reference wave which can initiate an arbitrarily complex hologram representing biological program. Sender has the ability to generate and amplify the frequencies which induce holograms representing the control commands. In particular, in living matter sender can initiate complex biological programs without knowing anything about their functioning.

One can distinguish between psychokinesis applied to living matter and “dead” matter.

1. When the target consists of living matter the mechanisms would be same as in communications between magnetic and biological bodies making possible bio-control of biological body by magnetic body and the receipt of sensory input from biological body by magnetic body. Hypnosis would be one example of this kind of interaction.
2. Remote mental interactions in the case “dead” could use simpler variants of the fundamental mechanisms utilized in living matter. For instance, zero energy ontology assigns with the CD of electron and quarks time scales .1 s and 1 ms defining fundamental biorhythms. The CD assignable to elementary particles could be involved also with psychokinesis. Negentropic entanglement could be essential for the transfer of metabolic energy (say in simple psychokinesis moving an object) and for control actions -say in intentional change of sequences of binary digits produced by random number generator. Target system would not be completely “dead”. Thermodynamical restrictions favor large values of Planck constant.

The basic problem in many remote mental interactions such as the intentional effect on random number generator is “Who knows how?”. How the mere intent can be transformed to action without any knowledge about the details of the action? The attempt to understand how neuro-feedback affect the behavior of single neuron leads to the same question.

1. Magnetic mirrors make possible also feedback and this feedback could make possible learning. For instance, in psychokinesis (especially so in micro PK), this learning would be crucial and analogous to that what occurs when we learn to drive a car. In healing this kind of feedback might help to find the healing frequency by trial and error.
2. It is quite possible that also multibrained and -bodied higher level collective selves actively participate in the process as a third party such that the remote mental interactions would act as a relay states. I have suggested similar explanation for Sheldrake’s findings about learning at the level of species and Tiller’s findings about the “transfer of intent”. This could make possible coherent amplification effects (TEM, prayer groups) and could make available information resources of all brains involved with the group. This could for instance explain the ability of a remote viewer to see an object on basis of data which need not have any meaning for her.
3. A fast amplitude modulation of alpha waves introducing higher harmonics to the carrier wave is a good candidate for mediating communication between brains and higher level multibrained selves. Mesoscopic “features” in brain involve precisely this kind of amplitude modulation and might represent just this kind of messages. Interestingly, also speech is produced by a fast amplitude modulation of 10 Hz basic vibration frequency of speech organs (assignable to electron CD as a fundamental frequency) and kHz (quarks) frequency is a special frequency from the point of view of hearing.

### 1.3.2 TGD Based Model for OBEs

Out-of-body experiences (OBEs) are often understood as experience of seeing oneself from a position outside of the body. OBEs are poorly understood in the framework of neuro science and pose a challenge for the reductionistic world view.

In TGD framework the notion of magnetic body provides an attractive starting point in attempts to understand what OBEs and related experiences are. The basic idea is that magnetic body serves effectively as a mirror defining a third person view as a cognitive representation also in ordinary wake-up state and that during OBEs this representation becomes sensory representation. Magnetic body need not always be a personal magnetic body but could correspond to a magnetic



body receiving information from several brains (collective consciousness), magnetic body of another person, or be even associated with “dead” matter.

The progress in identifying dark matter as a phase of matter with large value of Planck constant making possible macroscopic quantum coherence has led to the vision about dark matter at magnetic flux quanta as quantum controller of ordinary matter in living systems. The Bose-Einstein condensates of dark photons decaying via decoherence to ordinary photons mediate interactions between ordinary and dark matter and the hypothesis is that dark photon “laser” beams from body and brain reflected at magnetic flux quanta give rise to third person aspect of consciousness which in OBEs and related experiences are realized as sensory representations. The identification of bio-photons as end products of the de-coherence of dark photon beams is natural.

Zero energy ontology and the notion of causal diamond (or CD defined roughly as the intersection of future and past directed light-cones) brings additional quantitative ingredients to the model. Sub-CDs define embedding space ( $M^4 \times CP_2$ ) correlates for selves and by holography the 2-D partonic 2-surfaces at the light-like future and past boundaries of CDs are the ultimate space-time correlates for mental images. The moduli space for CDs makes possible a more detailed view about sensory representations.

A further new element is the vision about life as something in the intersection of real and p-adic worlds. The most important outcome is that the notion of number theoretic entanglement negentropy making sense in this situation is positive so that entanglement carries conscious information. The fusion of selves (in particular mental image) by negentropic entanglement is experienced as expansion of consciousness. It is negentropic entanglement between parts of biological body and corresponding parts of the magnetic body and biological body which makes living system living. This negentropic entanglement between magnetic body and biological body is important also for OBEs.

The model leads also to a model for dreams, hallucinations, sensory feedback from brain to sensory organs, and directed attention. Concrete models for how dark photons can give rise to experiences in various sensory modalities such as vision, hearing, olfaction, and tactile senses, are proposed.

### 1.3.3 TGD inspired view about remote mental interactions and paranormal

I have proposed a general vision about what remote mental interactions and related phenomena could be in TGD Universe around 2003. A lot of progress that has taken place since then, and this motivates the reconsideration of this vision. The general vision is that both biology, consciousness, and remote mental interactions and related phenomena labelled as paranormal are predicted to share the same basic mechanisms, and that the proposed vision provides basic concepts and the language allowing to speculate and build simple models. One cannot of course take the proposed models too seriously at the level of details.

The new ideas that have emerged since 2003 are summarized and parapsychological phenomena are discussed at general level. Also some applications of the basic vision are discussed. The notion of conscious hologram is discussed from the point of view of remote mental interactions. The notion of magnetic body is in decisive role as it is also in the understanding of quantum biology in TGD framework. TGD inspired model for OBEs relying on the notion of magnetic body is summarized. The idea is that OBEs could correspond to sensory experiences assignable to magnetic body rather than real body. Also the connections with the work of other researchers, such as Shnoll, Persinger, and Tiller are discussed briefly. The challenge of testing the vision is also considered.

### 1.3.4 How to test TGD based vision about living matter and remote mental interactions?

The general TGD inspired vision is that both biology, consciousness, and remote mental interactions and related phenomena labelled as paranormal share the same basic mechanisms. This purpose of this chapter is to summarize the new physics effects involved with the TGD inspired quantum view about consciousness and living matter and its applications to remote mental inter-

actions and related phenomena. Also tests are discussed when possible. By the universality of the mechanisms most of the tests reduce to tests for a new physics predicted by TGD.

### 1.3.5 Hypnosis as remote mental interaction

In TGD framework one can argue that hypnosis represents an example about the fact that brain is not “private property”: hypnotist uses the biological body and brain of the subject as instrument. Therefore remote mental interaction is in question. This idea generalizes: if one accepts self hierarchy, one can assign to any kind of higher level structure - family, organization, species, .... - a higher level self and magnetic body carrying dark matter, and these magnetic bodies can use lower level magnetic bodies as their instruments to realize their intentions. Biological bodies would be an important level in the hierarchy, which would continue down to cellular, molecular, and perhaps to even lower levels.

This view challenges the prevailing views about brain as a sole seat of consciousness and the assumption that conscious entities assigned with brains are completely isolated. Given magnetic body can use several biological bodies although one can assign to it the one providing the sensory input - at least during wake-up state. Note however that it is easy to produce illusion that some foreign object is part of biological body.

For more than decade ago I proposed a model for so called bicamerality based on the notion of semitrance. In semitrance the brain of subject becomes partially entangled with a higher level self - in this case the self of family or more general social group uses the biological body of member for its purposes. Higher level self gives its commands and advice interpreted by the bicameral as “God’s voice”. The consciousness of schizophrenic might be basically bicameral. Also hypnotic state and dream consciousness are candidates for bicameral consciousness.

In this article I develop essentially this idea but using as input the recent understanding of about TGD inspired theory of consciousness and quantum biology and end up with a proposal for a detailed mechanism for how the magnetic body hijacks some parts of the brain of the subject: prefrontal cortex and anterior cingulate cortex are argued to be the most plausible targets of hijacking. Also a mechanism explaining how the sensory hallucinations and motor actions are induced by hypnotist by inhibiting a halting mechanism preventing imagined motor actions to become real and sensory imagination to become “qualiafied”.

### 1.3.6 Meditation, Mind-Body Medicine and Placebo: TGD point of view

The chapter represents TGD inspired answers to Lian Sidorov’s questions concerning meditation, mind-body medicine and placebo in quantum biology framework. To help the reader, some aspects of TGD inspired theory of consciousness and quantum biology are summarized since several new insights inspired by the notions of magnetic body and dark matter have emerged lately. This includes improved views about quantum metabolism and prebiotic life: the basic input comes from the claimed free energy phenomena interpreted in TGD framework. Water structures representing simplified analogs of basic biomolecules suggested by water splitting producing so called Brown’s gas might be highly relevant also for the ordinary metabolism. The main new input concerning remote mental interactions comes from a possible answer to the question whether TGD based ontology of physics could allow the “shamanistic” view that the experiences (say encounters with strange life forms assigned with distant civilizations) induced by various psychedelics used in the spiritual practices of indigenous people could be genuine remote sensory perceptions rather than hallucinations. Affirmative answer would mean a direct and testable connection between neuropharmacology and remote sensory perception with serotonin defining the crucial neurotransmitter and pineal gland (“third eye”) serving as a candidate for the brain area of special importance in this respect.

Concerning the questions about meditation, mind-body medicine and placebo, the key concept is that of magnetic body. Usually organism and environment are seen as members of an interacting pair: organism receives sensory data from environment and controls it. Now magnetic body appears as a third party, “intentional agent” using biological body as a kind of interface between magnetic body and environment. Various “motor actions” of the magnetic body are highly relevant for both consciousness and biochemistry. The pairs formed by various information

molecules and corresponding receptors could define plug-ins to the Indra's net (or Internet) defined by the magnetic bodies and Josephson radiation emitted by Josephson currents assignable to receptors would propagate along flux tubes. Meditation can be seen as "bodily exercise" of the magnetic body and a method to improve the communications between magnetic body and biological body. In healing magnetic body would be the active participant and healing would be also the healing of magnetic body. The placebo effect could be seen as an outcome of intentions of magnetic body affecting biological body.

### **1.3.7 Non-locality in quantum theory, in biology and neuroscience, and in remote mental interactions: TGD perspective**

Non-locality seems to be a basic aspect of what it is to be living. Living system is elementary particle like coherent unit. The phenomenon of memory suggests temporal non-locality. Also remote mental interactions - if real - suggest non-locality. In fact, non-locality - both spatial and temporal - is the basic element of entire quantum TGD, and in particular, of its applications to quantum biology, neuroscience, theory of consciousness, and also of remote mental interactions.

In the sequel I make kind of pseudo deduction of the picture provided by Topological Geometrodynamics (TGD) by starting from empirical findings loosely related to non-locality rather than problems of General Relativity or of particle physics. The hope is that this could make the basic ideas of TGD easier to grasp. Also the mathematical framework and its interpretation as they are now are briefly discussed and the some applications to TGD inspired theory of consciousness and quantum biology are discussed.

## Chapter 2

# Quantum Model of Paranormal Phenomena

### 2.1 Introduction

The violent encounters with skeptics have demonstrated to me that surprisingly many skeptics refuse to even consider the possibility of taking paranormal phenomena seriously because they take the materialistic-reductionistic world view as the final truth. Usually the discussions reduce to the attempt to give me a label of a pseudoscientist because I do not possess an influential position in the scientific community; because I have not published my work in respectable journals; etc..., and it is very difficult to dig even a single bit of information relating somehow to the actual contents of my work. Regrettably this seems to be the case for most of arguments used by those who appear publicly as skeptics. Needless to say, skepticism in this sense has nothing to do with skepticism in the real sense of the word. Just the opposite, these “skeptics” identify themselves as the mind police of the dominating materialistic-reductionistic science and see as their holy goal the identification and ridicule of the scientific dissidents as pseudo scientists. For instance, I have been blamed for super-naturalism because I have been forced to introduce the notion of quantum jump between quantum histories forcing in turn to give up the notion of observer independent objective reality. The attempts to defend this vision by telling that this is the only possible logically consistent view about quantum jump forced by General Coordinate Invariance alone and solving the basic paradoxes of modern physics have been waste of time.

There are of course notable exceptions to this rule of thumb: Susan Blackmore represents an example of an intellectually honest skeptic who respects also the different world views and takes materialistic dogma only one possible view about world which must be also subjected to testing.

The basic objection against paranormal phenomena by skeptic researchers such as Susan Blackmore, is that there is no theory of paranormal phenomena making possible meaningful experimental tests so that the minimal working hypothesis is that these phenomena do not exist. The absence of a theory certainly makes experimental approach extremely difficult: a good analogy of the situation is provided by the high energy elementary particle physics where the enormous amount of data and noise makes possible only the detection of signatures predicted by various theories by comparing highly detailed Monte Carlo simulations of model world with the data.

Personally I however see this attitude as counter productive: I agree with someone who said that the worst form of ignorance is to regard un-explainable as a synonym of impossible. I find it also very entertaining to play “what if this is true” games with thoughts rather than adopting the somewhat boring role of a serious scientist. These thought games also often lead to ideas which need not be even related to the original question. I however hasten to admit that my attitude does not derive from a mere open-mindedness and mere desire to play thought games but from the simple facts of life: TGD indeed provides a conceptual framework in which paranormal phenomena might be understood and studied; secondly, as an eternally unemployed scientific dissident I really do not have anything to lose anymore.

### 2.1.1 What One Means With Paranormal?

According to Wikipedia definition [J11] paranormal is a general term that designates experiences that lie outside “the range of normal experience or scientific explanation”, or which indicates phenomena understood to be outside of science’s current ability to explain or measure. Nothing wrong with this but the text continues: “Paranormal phenomena are distinct from certain hypothetical entities, such as dark matter and dark energy, insofar as paranormal phenomena are inconsistent with the world as already understood through empirical observation coupled with scientific methodology”.

The latter sentence contains two intellectually dishonest claims typical for skeptics. First of all, contrary to the claim dark matter and energy are far from being understood within the recent main stream view about physics and very many theoreticians question their existence. Secondly, paranormal phenomena are just something that we do not understand just like dark matter and energy rather than “being inconsistent with empirical observation coupled with scientific methodology”. The irony is that in TGD Universe the scientific explanation for dark matter and dark energy supports also the reality of various paranormal phenomena.

The article continues by creating the impression that people taking seriously paranormal phenomena are blind believers and puts the main emphasis on ghosts, haunts, and other spiritual entities and gives only a minor emphasis on phenomena studied systematically in laboratory. To add irony: TGD inspired theory of consciousness predicts an infinite self hierarchy and dark matter is in an essential role in making this hierarchy possible. Depending on one’s tastes one can call these higher level entities higher level selves or angels but the possible existence of these entities as such is in no way inconsistent with the scientific methodology.

To make clear my own position: I am anomalistic in the sense that I do not either believe or not-believe. I am just ready to accept also observations which do not conform with the expectation of science as it is five centuries after Newton and try to understand them in a wider conceptual framework rather than trying to ridicule anomalies by mis-using formal scientific authority.

### 2.1.2 Development Of Ideas About Paranormal

During years I have developed several ideas about paranormal phenomena and, believing that there must be very few general principles behind these phenomena, I try to combine these ideas into a single coherent conceptual framework in this chapter. For the convenience of the reader it is good to summarize the evolution of the basic concepts briefly.

1. On the experimental side the most important boosts came from the lecture of Cyril Smith about homeopathy in CASYS’2001 conference [I11] and from the contact with Lian Sidorov and from reading her articles related to remote vision and healing [J65]. Also the work of Gariaev’s group on wave aspects of DNA [I16] was important for the concretization of the ideas. Of course, without the already existing view about living matter as symbiosis of MEs, of superconducting magnetic flux tubes, and of ordinary biomatter at atomic space-times sheets- a view that was inspired the information about effects of ELF em fields on brain [J69] and by the strange findings challenging the notions of ionic pumps and channels [I23] - these developments would not have been possible.
2. On the theoretical side the realization that p-adic physics provides the physics of cognition was a decisive breakthrough. The realization that number theoretic variant of Shannon entropy can be negative led to the idea of number theoretic entanglement negentropy but it took years to realize the profound implications of the notion, which can be summarized by the statement that living matter is a number theoretically quantum critical phase residing in the intersection of real and p-adic worlds.
3. The lectures of Peter Marcer about quantum holographic brain provided an important stimulus leading to the realization that MEs (massless extremals) serve among other things also as quantum holograms. The ideas about magnetic mirrors (ME-parallel magnetic flux tube pairs) acting as electromagnetic bridges between living subsystems and about liquid crystal blobs representing and amplifying the rotational, vibrational, etc. spectra of molecules, are the most recent newcomers in the zoo of ideas.

4. The resulting concrete view is that living organisms at all levels of the hierarchy are connected by the magnetic mirrors serving as electromagnetic bridges between them and making possible high precision directed communication, remote sensing, sensory representations using magnetic sensory canvas, memory as communication between the geometric past and geometric now, and remote control. Even the claimed communications with deceased can be seen as being based on the same mechanism as long term memory. Besides classical signalling with light velocity quantum entanglement (also time-like) mediated by MEs is key element of model and makes possible sharing of experiences. By fractality the same basic mechanisms are at work in all length scales: water memory and our long term memory are the same phenomenon but in different length scales. Similarly, the miraculous molecular recognition mechanisms and remote healing and vision are also phenomena based on the same basic mechanisms.
5. A further strong support for the idea that biosphere is a fractal organic whole came from the realization that the notion of psychological time leads to paradoxes unless one assumes that psychological time corresponds to the space-time region at which macroscopic volition is concentrated: this front of volition proceeding in the direction of future is where the p-adic-to-real phase transition changing intention to macroscopic action dominantly occurs. The original detailed realization of this view is in conflict with the recent view inspired by zero energy ontology and the notion of causal diamond (CD) and suggesting that the arrow of psychological time at space-time level and the localization of sensory experience in a narrow time interval is an outcome of intentional action and could be understood via a generalization of Negentropy Maximization Principle implying that selves can be regarded as curious entities [K6].

### 2.1.3 Topics To Be Discussed

The flow diagram for this chapter looks like following.

1. I propose a general vision about the mechanisms behind the paranormal phenomena based on the ideas briefly summarized. This involves the new view about psychological time, p-adic physics as the physics of cognition, the notion of negentropic entanglement, the notion of magnetic mirrors, LC crystal water blobs as mimicking electromagnetically molecules and amplifying signals em signals, field representation of the genetic information based on magnetic mirrors, a general model for remote mental interactions, and the proposal that stochastic resonance serves a universal amplification mechanism.
2. Some paranormal phenomena in biological length scales are considered. A model for healing by time reversal is formulated and Priore's machine is discussed in this framework with an attempt to understand the situation quantitatively. Also a model the delaWarr camera are discussed is proposed.
3. Parapsychological phenomena like extrasensory perception, precognition, psychokinesis, near-death experiences, and communications between living and dead are discussed: remote healing and vision are discussed also in [K40].
4. A TGD based model for the instrumental transcommunication (ITC), in particular electronic voice phenomena (EVP), is developed in more detail (I am grateful for Adrian Klein for informing me about these phenomena).
5. Adaptive robots of Mark Tilden behave very much like living creatures and the possibility that this might actually be the case is considered.

TGD based view about remote mental interactions have developed considerably with the TGD based quantum model of living matter but I have not dicusses these developments to this chapter in detail. Suffice it to say that the mechanisms of TGD inspired quantum biology and model of remote mental interactions are same.

I want to emphasize again to the blood-thirsty skeptics that I am not believer nor non-believer. These phenomena, be they actual or not, are extremely stimulating for a theorist with

a trait to creative thinking and have helped me to understand what in the TGD universe is new and impossible in the reductionistic and materialistic universe of the skeptic. Certainly the ability to explain these not-finally established phenomena does not make TGD pseudo science. In the same way, the ability of TGD based vision to say something nontrivial about religious experience and consciousness after the physical death does not mean that TGD replaces scientific explanation with a religious dogma (also this point I have been forced to explain again and again to some of my very skeptic friends).

The appendix of the book gives a summary about basic concepts of TGD with illustrations. Pdf representation of same files serving as a kind of glossary can be found at <http://tgdtheory.fi/tgdglossary.pdf> [L15].

## 2.2 General View About Paranormal Phenomena

According to Wikipedia definition [J11] paranormal is a general term that designates experiences that lie outside “the range of normal experience or scientific explanation”, or which indicates phenomena understood to be outside of science’s current ability to explain or measure. Nothing wrong with this but the text continues: “Paranormal phenomena are distinct from certain hypothetical entities, such as dark matter and dark energy, insofar as paranormal phenomena are inconsistent with the world as already understood through empirical observation coupled with scientific methodology”.

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### 2.2.1 The Notion Of Magnetic Mirror

Magnetic flux tubes and MEs are basic structures in TGD based model of biosystems based on the symbiosis of MEs, magnetic flux tubes and ordinary biomatter at atomic space-time sheets. Magnetic flux tubes are topological field quanta of magnetic field whereas MEs (“massless extremals”) are topological field quanta of radiation field, “light rays”.

Magnetic mirrors formed by the magnetic flux tube-ME pairs occur in many different contexts in TGD inspired theory of consciousness. For example, magnetic mirrors of length of order lightlife appear in the model of long term memory. Classically: when I (whose correlate is magnetic body) look at sufficiently distant mirror I see the me of the geometric past as it is represented by the mental images created by brain. Quantum mechanically: time-like quantum entanglement made possible by the magnetic mirror makes it possible for the self of the geometric now to share the experience of the sub-self of the geometric past. Magnetic mirrors can be said to define a fundamental model for sensory-motor loop.

Magnetic mirrors are crucial for the model of the sensory canvas [K45] and there seems to be no sharp difference between different types of memory which suggests that there is an entire hierarchy of memories in various p-adic time scales. Magnetic mirrors play a key role in the

model of frequency imprinting and provide a general molecular recognition mechanism. Magnetic mirrors allow also a generalization of many-sheeted DNA so that magnetic mirrors represent genetic information in electromagnetic form [K40].

In accordance with the fractality of consciousness, the wide applicability of the magnetic mirror notion suggests that various functions associated with the magnetic mirrors are different aspects of the same basic phenomenon. Magnetic mirrors would thus provide sensory canvases, long term memory mirrors and recognition mechanism at all length scales. Even many-sheeted DNA would possess sensory canvas and long term memories, perhaps an entire hierarchy of them. Taken the ideas of fractality and quantum hologram to extreme, one can even consider the possibility that our long term memories are average of those associated with genes associated with various neurons! Nothing precludes the possibility that magnetic mirrors can also serve as electromagnetic bridges between different organisms (even the notion of organism must be generalized if the idea of multi-brained magnetic selves is taken seriously). This could make possible effects similar to observed at DNA level (such as self assembly and translation of RNA to proteins made possible by electromagnetic recognition mechanism based on em bridges).

The latest application of the notion of magnetic mirror is to TGD inspired biology [K74]. Magnetic mirrors in this case appear as pairs of flux sheets assignable to the strands of DNA. The flux tube sheet going through the passive strand mediates sensory information coming from cell and nuclear membranes via magnetic flux tubes to various levels of the magnetic body whereas the flux tube going through the active strand mediates control commands of the magnetic body initiating gene expression with transcription being only one particular kind of gene expression. The intronic parts of DNA are assumed to be involved with topological quantum computation type activities in this model [K3]. One can say that DNA double strand takes the role of brain of cell and the passive and active sections of strands are analogous to sensory and motor areas of brain hemispheres. Also the analog of lateralization of brain functions is suggested to take place at the level of DNA and reflect itself in the character of gene expressions of the two strands (both strands contain sections expressed also in standard sense).

The hierarchy of Planck constants is essential element of the model and leads to a generalization of the notion of genome: magnetic flux sheets integrate sequences of genomes to larger super genome involving genomes of several cells and these in turn can integrate in longer hypergenomes. This could give rise to a collective gene expressions at the level of organelle, organ, organism, and even population. In the case of remote mental interactions applied to living target this model defines a natural starting point since all tools for remote sensory perception and motor action are available in standard form. Also the existence of collective gene expression would bring in new insights: for instance, the notion of species memory proposed by Sheldrake could be realized in this framework.

## 2.2.2 Summary Of The Model

The general quantum model for bio-systems leads to a model for bio-control which applies to a very wide variety of hard-to-understand bio-chemical phenomena such as molecular recognition mechanisms, water memory, and homeopathy and leads to a generalization of genetic code explaining the mystery of introns. The same model generalizes to a model of paranormal phenomena such as psychokinesis, remote sensing, remote healing, telepathy, communications with deceased, and instrumental transcommunications. The basic difference is that magnetic body receives information and controls “foreign” biological (or even magnetic) body or “dead” matter system.

### Key ideas

1. The basic notions of the model are magnetic body as an intentional agent controlling biological body and receiving data from living body or even “dead” matter system with massless extremals (MEs) mediating these communications, zero energy ontology and the related notion of causal diamond (CD) serving as an embedding space correlate of self and assigning to elementary particles fundamental macroscopic time and length scales as those of CD, the hierarchy of Planck constants making possible macroscopic quantum phases and zoom-ups of quantum systems, and the vision about living matter as something residing in the intersection of real and p-adic worlds and the closely related notion of negentropic entanglement crucial



for the functioning of living matter and conscious intelligence in TGD Universe. Note that this means that life corresponds to number theoretical quantum criticality in a well-defined sense.

2. Zero energy ontology means a radical departure from standard physics. The creation of zero energy states from vacuum is possible and means that in principle the claims of parapsychologists about ectoplasm and of yogis about the possibility to create of matter from nothing are consistent with the basic conservation laws of physics. In TGD inspired biology this process could take place routinely. Causal diamond is the embedding space correlate for the zero energy state. Positive and negative energy parts of the state reside at its boundaries. p-Adic length scale hypothesis and number theoretical vision suggest that the proper time distance between the tips of CD comes as powers of two. For electron and quarks playing key role in the model of DNA as topological quantum computer this temporal distance would correspond 1 seconds and 1 millisecond respectively suggesting a direct connection between elementary particle physics and basic bio-rhythms.

The translates and Lorentz transforms of CDs are also CDs and one can assign to CDs a moduli space further expanded by the introduction of the hierarchy of Planck constants. One expects that this moduli space is crucial for understanding of the geometric qualia [K76]. The communications between sub-selves would be naturally based on resonance. CDs are characterized by resonance frequencies which in the rest system of CD come as harmonics of the fundamental frequency determined by the proper time distance. This would allow a universal coding of geometric data using frequencies. Both MEs and CDs could be regarded as being analogous to music instruments and this in fact explains basic facts about music experience. These resonance frequencies should play a key role in biology and also in remote mental interactions- even those in which target consists of “dead” matter since fundamental biorhythms characterize also elementary particles in TGD Universe.

3. p-Adic physics as physics of cognition is an essential element of approach. Cognitions/thoughts are represented as p-adic space-time sheets. In the intersection of real and p-adic worlds these space-time sheets have a mathematical representation making sense also in real context so that one can say that these surfaces are in the intersection of real and p-adic worlds.

The original hypothesis was that quantum transitions between surfaces belonging to different number fields are possible: this would mean dispersion between real and p-adic sectors of “world of classical worlds” (WCW). One could say that particle is in one number field at time. This would make possible transformation of intentions to actions and their reversals possible via the intersection of real and p-adic worlds. It has turned out that this hypothesis is not mathematically attractive.

Rather, the real and p-adic number fields form a book like structure with an algebraic extension of rationals as its back. Any physical system corresponds to pieces at all pages of this Big Book. Same applies at the level of embedding space, space-time surfaces, and WCW. In this framework holography makes it possible to understand real and p-adic space-time surfaces as continuations of string world sheets and partonic 2-surfaces to space-time surfaces, either real or p-adic. The string world sheets themselves are in the intersection of reality and various p-adicities in the sense that the parameters characterizing them belong to an extension of rational numbers. What makes this option so elegant is that one avoids the tension between continuity and symmetries. All symmetries make sense in both real and p-adic sectors and the problem with continuity does not appear at all since one does not try to map reals to p-adics or vice versa.

4. Negentropic entanglement, which can be both space-like and time-like in zero energy ontology, makes possible quantum superposition of macroscopically different configurations of the target system correlated with the states of operator system. The operator should be able to achieve the negentropic entanglement and intentionally increase the amplitude of the desired outcome in this superposition. Negentropic entanglement need not involve binding energy and I have proposed this as a deeper level explanation for the nebulous notion of high energy phosphate bond crucial for metabolism in living matter. Quite generally, negentropic entanglement would make possible for the operator to transfer metabolic energy and momentum

to the target. The hierarchy of values of Planck constant would make possible this process in long time and length scales.

### A more concrete model

The following would represent the concrete model what happens in remote mental interaction.

1. Magnetic mirrors (ME-magnetic flux tube pairs) connecting the sender and receiver make possible a universal mechanism for the transfer of intent and action. The pair of flux tubes forms a kind of sensory-motor loop. In biology the fundamental realization could be by a pair of flux sheets going through the strands of DNA with passive strand sending sensory data to the magnetic body and active strand receiving control commands leading to various forms of gene expression. MEs are ideal for the transfer of both classical information and momentum.
2. Real MEs represent the action. Also smaller MEs can be send along the MEs serving as bridges (this is like throwing balls with light velocity!). In this case one can speak about transfer of intent and of action.
3. MEs give rise to remote interaction which can act both endo- and exogenously. Magnetic mirrors as characterized by their fundamental frequencies make possible bridges between sender and receiver (say healer and healee) and allow a resonant interaction in which healer can initiate various control commands acting as 4-dimensional templates represented as holograms. Also CDs are characterized by fundamental frequencies and MEs and CDs must be in resonance. This makes very strong predictions about resonance bands due to the possibility of Lorentz transforms of CDs. For non-relativistic boosts for CDs the bands have however width of order  $\Delta f/f \sim v/c$  and are therefore very narrow.
4. The ME-magnetic flux tube pair connecting sender and receiver can can initiate an arbitrarily complex hologram representing biological program if the wave pattern assignable to ME interferes with a reference wave associated with the receiver. Sender has the ability to generate and amplify the frequencies which induce holograms representing the control commands. In particular, in living matter sender can initiate complex biological programs without knowing anything about their functioning and the challenge of the operator is to learn these control commands. The situation resembles that encountered in neuro feedback.

### Remote mental interactions with living *resp.* “dead” matter

One can distinguish between psychokinesis applied to living matter and “dead” matter.

1. When the target consists of living matter the mechanisms would be same as in communications between magnetic and biological bodies making possible bio-control of biological body by magnetic body and the receipt of sensory input from biological body by magnetic body. Hypnosis would be one example of this kind of interaction.
2. Remote mental interactions in the case “dead” could use simpler variants of the fundamental mechanisms utilized in living matter. For instance, zero energy ontology assigns with the CDs of electron and quarks time scales. 1 s and 1 ms defining fundamental biorhythms. The CDs assignable to elementary particles could be involved also with psychokinesis. Negentropic entanglement could be essential for the transfer of metabolic energy (say in simple psychokinesis moving an object) and for control actions -say in intentional change of sequences of binary digits produced by random number generator. Target system would not be completely “dead”. Thermodynamical restrictions favor large values of Planck constant.

### Who knows how?

The basic problem in many remote mental interactions such as the intentional effect on random number generator is “Who knows how?”. How the mere intent can be transformed to action without any knowledge about the details of the action? The attempt to understand how neuro-feedback affect the behavior of single neuron leads to the same question.

1. Magnetic mirrors make possible also feedback and this feedback could make possible learning. For instance, in psychokinesis (especially so in micro PK), this learning would be crucial and analogous to that what occurs when we learn to drive a car. In healing this kind of feedback might help to find the healing frequency by trial and error.
2. It is quite possible that also multibrained and -bodied higher level collective selves actively participate in the process as a third party such that the remote mental interactions would act as a relay states. I have suggested similar explanation for Sheldrake's findings about learning at the level of species and Tiller's findings about the "transfer of intent". This could make possible coherent amplification effects (TEM, prayer groups) and could make available information resources of all brains involved with the group. This could for instance explain the ability of a remote viewer to see an object on basis of data which need not have any meaning for her.
3. A fast amplitude modulation of alpha waves introducing higher harmonics to the carrier wave is a good candidate for mediating communication between brains and higher level multi-brained selves. Mesoscopic "features" in brain involve precisely this kind of amplitude modulation and might represent just this kind of messages. Interestingly, also speech is produced by a fast amplitude modulation of 10 Hz basic vibration frequency of speech organs (assignable to electron CD as a fundamental frequency) and kHz (quarks) frequency is a special frequency from the point of view of hearing.

#### Why paranormal phenomena are so rare?

The model should be also able to explain why it is so difficult to show that paranormal phenomena are real.

1. The very fact that experimenters usually do their best to eliminate subjective elements from the experimental arrangements might explain why paranormal phenomena are so poorly reproducible.
2. Field bodies apply naturally to personal biological body basic mechanisms of remote mental interactions and the evolution of a kind of immune system preventing the access of foreign field bodies to personal biological body looks very natural.
3. The basic prediction of zero energy ontology is breaking of second law of thermodynamics in the time scale of CD considered. In sufficiently long scale averaging however destroys the anomaly and statistical argument can be also used to support the claim that the breaking was only a statistical fluctuations. Zero energy states are indeed counterparts of vacuum fluctuations in standard physics. It is also quite possible that in the statistical averaging these phenomena indeed disappear and it might be more reasonable to concentrate on the character of the fluctuations around the average. An interesting analogy is the research of Shnoll related to the fluctuations of radioactive and chemical rates which demonstrated clear periodicities in fluctuations correlating with astrophysical periods [E3] , [E3]. Perhaps this approach might be applied also to the claimed paranormal phenomena.

This model explains a wide variety of observations related to remote healing and vision [J65]: these observations are discussed in [K40]. Since magnetic mirrors can connect also living organisms and "dead" mater, say electronic instruments, the model can be applied to explain also phenomena like micropsychokinesis, causal anomalies related to machine-animal interaction, and so called instrumental transcommunications.

## 2.3 Paranormal Phenomena In Biological Systems

In this section a TGD inspired model for healing based on time reversal bringing the system back to the healthy state is proposed. Priore's machine is discussed as an application of the model. Also the weird sounding claims about delaWarr camera are discussed in the general conceptual framework.

### 2.3.1 Healing By Time Reversal

The article of Lian Sidorov [J65] and its references give a thorough view about remote healing and viewing. One particular healing method goes under name Qigong (see the article [J28]). Qigong is a general term for a large variety of traditional Chinese energy exercises and therapies. Qigong is generally considered as a self-training method or process through Qi (vital energy) and Yi (consciousness or intention) cultivation to achieve the optimal state of both body and mind. The traditional Chinese medicine postulates the existence of Qi, which could be regarded as a kind of subtle energy circulating around the physical body.

Zero energy ontology in principle makes possible the creation of matter from vacuum as zero energy states. This process involves a generation of a new CD serving as a correlate for self carrying positive and negative energy parts of the zero energy state at its future and past boundaries. The standard physics interpretation would be as a quantum fluctuation in a space-time volume dictated by CD. At space-time level space-time sheets within CD would be the correlate. Also the transformation of p-adic space-time sheets to real ones and vice versa in the intersection of real and p-adic worlds becomes possible.

Massless extremals are excellent candidates for the space-time correlates of communication and control signals and depending on the sign of the energy can propagate in both time directions. Real bosons correspond to wormhole contacts connecting positive (negative) energy MEs whereas virtual bosons are identified the wormhole contacts connecting positive and negative energy MEs. In zero energy ontology it makes sense to speak about quantum jumps transforming p-adic MEs to real ones and about reflection of MEs in time direction so that positive energy ME transforms to negative energy ME or vice versa. Also MEs analogous to virtual particles are possible. They correspond to pairs of MEs with opposite time orientations so that the wormhole throats carry opposite signs of energy. In this case the classical momentum is not anymore light-like and although wormhole throats are massless the boson itself can be interpreted as a virtual off-mass-shell particle.

In quantum optics time reversal is known as a phase conjugation [D5] and is one of the basic notions of holography. MEs act as both quantum holograms and receiving and sending quantum antennae [K62]. MEs can generate reference waves of coherent photons interacting with other MEs and activating dynamical holograms of coherent light. If the reference wave is phase conjugated, the resulting hologram is time reversed.

What makes this so interesting is that MEs and magnetic flux tubes are the tools of quantum control in the TGD based view about biosystem as a symbiosis in which MEs control superconducting magnetic flux tubes controlling ordinary matter at atomic space-time sheets via the many-sheeted ionic flow equilibrium. The coherent light pattern emitted by ME resulting from the interaction of ME with the reference wave (its phase conjugate) could act as a control command (time reversed control command) inducing process (time reversed process). Conjugate reference waves would thus provide an incredibly simple and general mechanism of healing by time reversal allowing the living matter to fight against second law. This would be like a general initiating a war by just nodding or shaking his head.

#### What time reversal for biological programs could mean?

Of course, one can ask what one precisely means when one says that biological program runs backwards.

1. In zero energy ontology the most natural interpretation would be that the arrow of geometric becomes non-standard for some sub-CDs of the CD defining the standard arrow. Time reversal would take place always in some time scale. In the case of healing the reversal would be induced for the population of sub-CDs to be healed. The healing mechanism would require only the reversal of the arrow of time. The details of the biological programs would not matter.
2. The time scales of sub-CDs in question would correspond to the time scales of the biological functions in question and the time scale would be proportional to the value of Planck constant involved. There is direct experimental evidence [D4] that the time direction assigned to the second law changes in time scale of.1 seconds defining the time scale of electronic CD: this

is discussed in detail in [K52]. Miraculous healings in which healing occurs instantaneously could be understood if this interpretation is correct.

The basic question is how to induce the time reversal in a given time scale and here one can make even guesses. The argument for the arrow of geometric time [K6] is based on the generalization of NMP [K52]: sub-selves are curious about what is outside CD and tend to concentrate near either light-like boundary of CD and to induce quantum jumps shifting the quantum superpositions of space-time sheet backwards in geometric time of space-time sheet so that the stationary sub-self is like a stationary object in flowing river and experiences an apparent time flow. Perhaps a powerful enough time reversed signal from the past boundary of CD could stimulate the curiosity of sub-selves and induce the migration or creation of the sub-self-population to the past boundary. Maybe phase conjugate coherent radiation could define this signal.

### Qigong from TGD point of view

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In TGD framework the energy associated with MEs and supercurrents flowing along magnetic circuitry could be a natural counterpart of Qi. The positive metabolic energy assignable to negentropic entanglement or negentropic entanglement (see **Fig.** <http://tgdtheory.fi/appfigures/cat.jpg> or **Fig.** ?? in the appendix of this book) could be an alternative identification for Qi. If entanglement is entropic it corresponds to bound state entanglement and this entanglement of its negative metabolic energy could be seen as the counterpart of “sick Qi”.

Yi could in turn would translate to p-adic cognitive representations representing also intentions, perhaps p-adic variants of MEs or even magnetic mirrors. Internal Qigong refers to self healing whereas external Qigong means directing Qi energy or intention to help others by opening Qi blockages or inducing the sick Qi to get out of body, or helping to achieve Qi balance. The transfer of metabolic energy by ATP-ADP process [?] would be basically a transfer of negentropic entanglement in TGD framework and Qi blockage could be interpreted as a blockage preventing transfer of this entanglement (of metabolic energy in standard framework).

The physiological, chemical and electromagnetic effects of both internal and external Qigong have been studied ( [J65] contains large number of related references). Also the effects of Qigong healing on cancer has been studied [J28].

### Priore's machine

There is also some empirical support for the idea about healing by time reversal coming already from the period when only Soviet scientists knew about phase conjugation.

1. In 1960's and 1970's French Antoine Priore built and tested electromagnetic healing machines of startling effectiveness [I25]. Tom Bearden has in this website document “The Priore Machine and Phase Conjugation” which I recommend for an interested reader for a more detailed exposition [I7] besides the material that can be found from the homepage of Tom Bearden.
2. In hundreds of rigorous tests with laboratory animals, Priore's machine cured a wide variety of the most difficult kinds of terminal, fatal diseases known today. Many of the experiments and tests were done by prestigious members of the French Academy of Sciences. The operation of the Priore machine was incomprehensible for both the inventor and orthodox French scientists. Into a tube containing a plasma of mercury and neon gas, a pulsed 9.4 GHz wave modulated by a frequency of 17 MHz was introduced. The waves were produced by radio emitters and magnetrons in the presence of a 1200 Gauss magnetic field. Experimental animals were exposed to this magnetic field during irradiation, and the mixture of waves

(about 17 or so) coming from the plasma tube and modulating and riding the magnetic field passed through the animal's bodies.

The following observations suggests that TGD inspired model for bio-control and communication might allow to understand the claimed findings.

1. A combination of magnetic fields and radiation was involved: this conforms with the vision about biosystems as a many-sheeted ionic flow equilibrium controlled by MEs attached to flux tubes and sheets.
2. It is known that phase conjugated waves can be produced in plasmas. The so called four-wave interaction of waves of equal frequency is the simplest manner to amplify weak wave in the effective dynamical diffraction grating defined by the interference of two waves propagating in opposite directions. If a phase conjugate wave with a correct frequency results in this kind of situation, it could act as a reference wave acting with ME and initiate a complex time reversed biological programs at subcellular level.

Metabolism is what drives biological programs and their time reversal could involve the time reversal of the basic metabolic mechanism.

1. According to the quantum model of metabolism [K43], ADP-ATP cycle corresponds to a cyclic flow of protons between some larger space-time sheet (say  $k = 169$ ) and  $k = 137$  atomic space-time sheet. The so called  $F_0 - F_1$  machine transforming ADP to ATP drives the biological Karma's cycle kicking protons to the atomic space-time sheet, where they dissipate their energy and drop back to the magnetic flux tubes liberating their zero point kinetic energy of about .5 eV. TGD suggest the existence of metabolisms associated with other ions and between other space-time sheet pairs, and the universal energy currencies of these metabolisms are characterized by the zero point kinetic energies of the ion in question. Standard metabolism is a particular example of this general process, and there might exist analogs of  $F_0 - F_1$  machines corresponding to other metabolisms. The cycle of ATPase motor is of order 300 Hz, which is the proton cyclotron frequency in the endogenous magnetic field of .2 Gauss.
2. The cyclotron frequency of the ions are assumed to be key frequencies in bio-control. Cyclotron frequency MEs server as space-time correlates of quantum entanglement, and the MEs with frequencies corresponding to zero point kinetic energies propagate along these MEs and induce self-organization at the receiving end. CDs define a further important time and secondary Compton frequency scale related to that for electron by the formula  $T_e(k) = 2^{k-127} \times r \times .1$  seconds,  $r = \hbar/\hbar_0$ . Here corresponds the p-adic prime characterizing the elementary particle. A basic speculation is that light fractally scaled counterparts of elementary particles with Compton lengths corresponding to biologically important Gaussian Mersennes  $k = 151, 157, 163, 167$  could be relevant for biology. These Compton time scales vary in the range  $1.6 \times 10^6$  s -  $6.4 \times 10^9$  s (18.5 days- 205.8 years)
3. Genes are the basic motor instruments of cell and the healing mechanism might affect directly the biological programs at this level. DNA as topological quantum computer paradigm would suggest that these programs are in in reserved time direction and that the size of structures involved is of order of typical unit of genome.
4. Healing process could correspond to the functioning of these machines in a time reversed mode: the generator becomes a motor. Even ordinary metabolism might become time reversed temporarily during healing process. Perhaps the fact that metabolism is minimized during rest, would allow also  $F_0 - F_1$  generators to temporarily run in the time reversed mode.
5. Four-wave interaction is believed to be involved with the generation of the phase conjugates of microwaves. The direct irradiation by the phase conjugates of a microwave beam at critical frequency might be a simpler manner to induce the healing process at DNA level.

By its extreme generality this mechanism could apply to almost any disease which is a disease of the highest level quantum biocontrol. This mechanism could be also used to induce de-differentiation of cells. The de-differentiation of cells to stem cells could be controlled by a similar mechanism. One can also wonder whether this kind of mechanism could make possible eternal youth (or rather eternal life) at cell level. An interesting question is whether the phase conjugates of EEG waves or time reversals of nerve pulse patterns could induce time reversals of brain functions.

The most recent view about healing by reversal relies on NMP. In the first state function reduction to opposite boundary of CD sub-self dies and re-incarnates as time-reversed self, which in statistical sense is more negentropic. Negentropy increase means healing. The next state function reduction to opposite boundary brings back the original healthier subself. Healing is like taking a snap and waking up refreshed. It would be natural to assume that the Becker voltage playing important role in the healing changes its sign in the reduction since time reversal of subself takes place.

One should of course be able to understand whether and why the frequencies used are special. The following represents the guesses inspired by the p-adic length scale hypothesis and cyclotron frequency hypothesis.

1. The effects of ELF em fields on vertebrate brain occur at cyclotron frequencies. Also in this case higher carrier frequency is used but its function is to make possible the penetration of the modulating ELF radiation to the tissue. Let us assume that 9.4 GHz radiation serves for a similar purpose.
2. Electron's cyclotron frequency in a magnetic field of  $B_{end}$ ,  $B_{end} = .2$  Gauss, the difference between  $n = 3$  and  $n = 0$  cyclotron frequencies of electron is in good approximation 17 MHz. This would suggest that cyclotron phase transition for electrons from  $n = 0$  to  $n = 3$  level is involved with the mechanism. This would support the assignment of proton cyclotron frequency for  $B_{end} = .2$  Gauss with ATPase motor and mean that both electrons and protons are important for the function of the machine.
3. For the standard value of Planck constant the frequencies correspond to energies much below the thermal energy at room temperature. The value of 17 MHz would suggest a value of order  $10^7 \hbar_0$  for the Planck constant. Negentropic entanglement might allow to circumvent this constraint.
4. The ratio of  $B = .12$  Tesla to  $B_{end}$  is  $B/B_{end} = 6 \times 10^3 \simeq 3 \simeq 2^{11}$ . The magnetic length  $L_B \propto \sqrt{\hbar/eB}$  characterizes the thickness of the flux tubes required by the minimum value of magnetic flux. The magnetic field used corresponds to about  $10^{-7}$  meters for the standard value of Planck constant and to a length scale about  $10^{-4}$  m for  $\hbar \sim 10^7 \hbar_0$ . For the ordinary value of Planck constant the corresponding space-time sheet could be associated with chromosome's basic structure and correspond to  $k = 157$  space-time sheet associated with chromosome's coiling. Note that the time size of the CD assinal to  $k = 157$  p-adic length scale is  $2^{30} \simeq .1$  s  $\simeq 10^8$  s. Optimistically one could imagine that correction of the genetic error responsible for the cancer program by time reversal might be in question. In particular, it could induce the time reversal of the "develop-cancer" program controlling the development of the cancer cell population and lead to healing when the standard time direction is re-established.

### 2.3.2 Delawarr Camera And Field Representation Of Genetic Information

In CASYS'2001 symposium Peter Marcer [131] told about the British engineer George DelaWarr who built a remote imaging camera in the 1950's (radionics is the term used). Using only a test object provided from the subject such as a small blood, sputum, or hair sample, this device is reported to photographically image the subject's internal conditions at a distance, with a high degree of accuracy. A unique feature of the DelaWarr system is claimed to be that it is able to detect diseases in the pre-clinical stages prior to detection by conventional techniques such as physical examination, X-ray, CT scan, or Magnetic Resonance Imaging. The photographs

taken by DelaWarr camera at fifties were treated by Susan Benford by modern image processing techniques and she claims that these photographs contain the information needed to reconstruct three-dimensional holograms [I31]. The proposed explanation was that the test object (adjunct) contains a hologrammic representation about the patient.

The functioning DelaWarr camera looks highly mysterious even when one takes seriously the idea that DNA generates holograms of the body parts it codes for. Therefore it is better to introduce the ingredients of the model as questions rather than hypothesis.

1. Was the intent of the photographer all that was needed and did other levels levels of the self hierarchy take care of the rest as they do when I make the decision to raise my hand? Could the intent of the photographer have generated a reference wave at some very special frequency acting on the adjunct and activating a hologram giving rise to a photograph about the desired body part or inducing a sequence of events leading eventually to the generation of the photograph?
2. Was the visible light giving rise to the photograph generated in the adjunct? Does the DNA of each cell of body and thus also of the adjunct contain electromagnetic representations for the body parts and are these representations more or less equivalent with holograms? Certainly direct hologrammic images about body parts would provide the simplest manner to realize the field part of the genetic code as proposed.
3. Did the adjunct serve as a relay station (somewhat like thalamus in brain) mediating the information from the patient via magnetic flux tube-ME pairs to the camera projecting it to the camera as a coherent light generating an ordinary photograph? Was the image realized as a coherent light propagating along the MEs connecting adjunct and patient serving as bridges? Could the negentropic entanglement between the adjunct and subject stabilize the connection. Could the radiation correspond to large  $\hbar$  radiation at much lower frequencies than that for visible light and transforming to ordinary visible light in the camera?

## 2.4 Parapsychological Phenomena

In this section various parapsychological phenomena are discussed in the general framework introduced in the previous section.

### 2.4.1 Extrasensory Perception, Precognition, And Other Parapsychic Effects

The general model for paranormal effects relies on same basic ideas as the model of quantum biology.

1. Paraphychic phenomena involve the transfer of information and negentropic entanglement makes possible genuine information at quantum level as also breaking of the second law of thermodynamics in the time scale of CD in question. Hence remote mental interactions should involve the generation of negentropic entanglement (see **Fig. <http://tgdtheory.fi/appfigures/cat.jpg>** or **Fig. ??** in the appendix of this book) irrespective of whether the target is living system or consists of “dead” matter.
2. The idea about field body serving effectively as an intentional agent is second element of the model. The topological light rays representing negative energy signals propagating into geometric past might be said to represent the “desire” inducing neural activities in the brain of geometric past. This mechanism provides not only a model for how magnetic body uses biological body as a motor instrument but also for PK.

MEs acting as bridges between different organisms would mediate em oscillations allow a directed transmission of smaller MEs behaving effectively as particles moving with light velocity. These MEs would have both real and p-adic parts, which -using the terminology of Qigong practice- would represent qi (action) and yi (intention) respectively. An essential



element would be resonance: sender and receiver in should be accompanied by MEs characterized by the same fundamental frequency: only these MEs could resonantly connect healer and healee. Healer must have ability to continuously vary the healing frequency.

MEs realizing the action as a signal proceeding to geometric past would naturally correspond to negative energy space-time sheets. They would be attached to magnetic flux tubes and magnetic mirrors consisting of two flux sheets would make possible sensory-motor loop.

That negative energy MEs would realize intentional actions/volitional acts/motor actions conforms with the recent view about quantum measurement theory in ZEO leading to a detailed view about the notion of self and about how the experience about flow of geometric time emerges.

3. Zero energy ontology justifies the notion of negative energy signals and brings in also CDs as correlates of selves and natural fundamental targets of remote mental interactions. Zero energy ontology and the new view about time allows to assume that sensory qualia are at the level of sensory organ (objections such as phantom leg phenomenon can be circumvented) and that symbolic representations of objects of perceptive field and their attributes reside in brain.

Sensory input generates sensory representations based on real space-time sheets possibly accompanied by p-adic cognitive space-time sheets. Field body can share these mental images by quantum entanglement and also receive sensory information as classical signals involving using frequency coding and coding by temporal patterns. These latter representations would correspond to cognitive and emotional aspects associated with the sensory input. One could even say that higher level sensory representations are somatosensory experiences of field body. The intersection points of real and p-adic space-time sheet would determine the physical cognitive representation and would be always discrete. The analogy with the discreteness of numerics should be noticed. Since this model would apply also to extrasensory perception, the attribute “extrasensory” becomes somewhat misleading attribute.

4. Extrasensory perception could also result from the direct electromagnetic perturbation of the sensory magnetic canvas outside the body and the sounds generated by auroras and meteors might be genuine “extrasensory” perceptions of this kind [K77]. The frequency spectrum for the sounds produced by meteors and detected both sensorily and electronically in the range 37 – 44 Hz [F3], which is the range of thalamocortical resonance frequencies associated with sensory representations in magnetic sensory canvas model. The sounds are several orders of magnitude more intense than they should be unless em perturbations propagate to Earth in a channelled manner. Only few meteors generate these sounds. These observations suggest that a resonant amplification of the em perturbations by magnetic mirrors of the sensory canvas channelling the em field to the surface of Earth are in question.
5. One might argue that if memes are not universal, remote cognition is not very useful. If memetic and genetic codes are realized in terms of CDs of quarks and leptons, one would have universality. If DNA double strand provides the relay station through which sensory input and motor output of the magnetic body flows, one would achieve universality of communication and control mechanisms at the level of living matter. An interesting question is whether memes are really species-specific as the morphic fields are in Sheldrake’s theory. The ability of shamans to transform at the level of conscious experience to animals suggests that this might not be the case. There is also a famous real life story about a student who spend several days in the experiential world of dog. Various identification phenomena would very probably involve also magnetic mirrors acting as bridges between say shaman and animal (or possibly multibody collective self defining “species self” ) and making possible to share the experience of animal. Same mechanism as in the case of long term memories would be in question but with personal memories being replaced with the experiences of another species.

The fact that p-adic space-time sheets can be said to have literally infinite size in real sense suggests that cognition and intentionality are cosmic phenomena and that there might be cosmic pool of shared cognitive mental images. Hence memes could be completely universal.

### 2.4.2 Psychokinesis

One can classify psychokinesis to various types depending on whether the target is living or “dead” and whether the effect on target is a mere transfer of energy and momentum or control action involving information transfer.

Below I briefly discuss an early TGD inspired model of PK, a general model of PK assuming time mirror mechanism (see **Fig. ??** in the appendix of this book) of ordinary intentional action but applied by the magnetic body of the operator to a system different from the biological body, and a more specific model for machine-human interactions. Also concrete examples of various kinds of PK effects are discussed.

#### A possible model for psychokinesis with non-machine targets

In [K112] a mechanism of psychokinesis based on the generation of wormhole magnetic field configurations making possible levitation was proposed. Although this mechanism was yet general it deserves a discussion and reader is recommended to see [K112] for details. Basic mechanism is the levitation of diamagnetic substances in an external magnetic field: the force results when the diamagnetic substance repels external magnetic field from its interior. The force is essentially the gradient of the net magnetic energy inside the volume defined by the object.

The mechanism is purely TGD based and relies on the generation of a pair of space-time sheets having opposite time orientations, and carrying opposite magnetic fields and opposite energy densities, and the subsequent interaction of the second space-time sheet with the object moved in the psychokinesis. Exactly the same mechanism applies in case of MEs (massless extremals) and could be used to generate coherent locomotion of organism resulting as a recoil effect when the second ME is absorbed by the body part. MEs provide a candidate for the mechanism of psychokinesis.

#### TGD based general view about PK

A general TGD based explanation psychokinesis relies on the same fundamental mechanism as ordinary intentional action, long term memory, and remote metabolism. The model applies more or less as such also to telepathy and could also allow to understand the notion of water memory explaining homeopathic effects.

1. The basic mechanism of PK and retro PK relies on quantum jumps generating real space-time sheets representing desires represented as negative energy signals to the geometric past. These signals modify the output of say random number generator to a non-random one. Magnetic flux quanta would realize the bridges along with the negative energy signals would propagate. The mechanism would favor retro PK if the operator is in active role. Genuine PK is also possible but in this case target would be active sucking metabolic energy provided by the operator.
2. Negative energy signals could consists of dark phase conjugate photons or even massless  $W$  bosons since TGD allows scaled up variants of electro-weak gauge bosons with large Planck constant and arbitrarily small mass scales. Dark  $W$  bosons are especially interesting since they can induce charged entanglement and purely non-local charge transfer mechanism and have been proposed to play a key role in the generation of the nerve pulse.
3. Magnetic flux quanta are the bridges making possible (presumably) unconscious feedback so that the operator can unconsciously learn how to affect the machine. How intentions can have effect on system whose functioning is unknown to the operator is actually the basic mystery of, not only psychokinesis, but of remote healing and remote mental interaction in general, as also of the phenomena labelled as instrumental transcommunications (ITC). The learning by feedback, much analogous to that happens when we learn to drive bicycle, would solve this mystery. The effects of group activity could be understood if groups tend to form collective selves so that coherent amplification of the effect occurs.
4. The ability of the PK able person to imagine the desired effect is important and could correspond to the ability to generate space-time sheets realizing the intention. The desire

about the action represented by the corresponding real space-time sheet should induce the effect optimally. In personal discussions with a PK-able psychic I indeed learned that he always tried to imagine in every possible detail how he moved the physical object (say a box of matches). The role of imagination is important also in remote healing [J65]. Perhaps the p-adic pseudo constants made possible by the non-determinism of p-adic differential equations should be in a good approximation genuine constants.

5. The optimal targets are initial value sensitive- or more generally-critical.
  - (a) Quantum criticality is the basic characteristic of TGD Universe and the prediction is the existence of a hierarchy of criticalities. Number theoretical criticality would in turn characterize living matter and might be a characteristic of optimal targets.
  - (b) Also quantum critical in the sense that several values of Planck constant are possible with large values of  $\hbar$  assignable to negative energy signals mediating the desire of the PK-able person. PK requires energy and this favors systems, which can utilize standardized metabolic energy quanta liberated in the dropping of particles to larger space-time sheets.
 

In many-sheeted space-time particles topologically condense at all space-time sheets having projection to given region of space-time so that this option makes sense only near the boundaries of space-time sheet of a given system. Also p-adic phase transition increasing the size of the space-time sheet could take place and the liberated energy would correspond to the reduction of zero point kinetic energy. Particles could be transferred from a portion of magnetic flux tube portion to another one with different value of magnetic field and possibly also of Planck constant  $\hbar_{eff}$  so that cyclotron energy would be liberated. In the following only the “dropping” option is discussed.
  - (c) Water would be an optimal system from the point of PK and retro PK. Homeopathy might indeed involve PK like aspects. Benveniste’s experiments [I14, I15] gave support for the notion of water memory but could not be replicated when the experimenters did not know in which bottles the treated water was. The preservation of water memories represented in terms of many-sheeted lasers for with  $1/0$  corresponds to a population inverted state/ground state, requires metabolic energy feed and the system might suck this metabolic energy from the biological body of the experimenter [K40].
6. As noticed, the proposed model is extremely general and seems to apply to almost any paranormal phenomena. For instance, the claimed re-incarnation experiences could be understood in terms of the general mechanism for long term memory. The person who remembers having lived in past could share mental images of a person in the geometric past by time like entanglement (episodal memory), or could be able to communicate with negative energy signals to the brain of a person on geometric past memory recall and thus receive declarative memories. It is quite possible that survival of fittest in our culture has led to an evolution of an immune system preventing sharing of mental images and communications with other brains.

### Machine-mind interactions

Machine-mind interactions represent a modern branch of parapsychological research and nowadays methodologically highly advanced. These interactions are studied several groups and individuals: mention only the Princeton Engineering Anomalies Research (PEAR), which is a group directed by Prof. Jahn, the Anomalous Cognition Project of Dick Bierman, and the retrosychokinesis work of Helmut Schmidt. In the sequel some aspects of this work are discussed.

The generation of negentropic time like entanglement between operator and target leading to a superposition of pre-existing and desired zero energy states and a subsequent increase of the amplitude of the desired outcome could be the general mechanism of machine mind interactions. “Who knows how?” is a highly relevant question in the case experiments involving the attempt of operator to affect the function of a machine like computer whose detailed functioning is not known for the operator. This question could have two answers. Either the operator learns to who to affect the outcome by the simple sensory-motor loop provided by MEs or there is third party who knows and corresponds to a higher collective level of consciousness.

### 1. *Retro psychokinesis with random number generators*

The analysis of experiments [J23, J24, J19] discussed in the [K106] suggests that the geometric past can change in the time scale of a fraction of second. Both the work done at PEAR [J32] and the work of Helmut Schmidt with retro psychokinesis [J52] provide support for the change of the geometric past in much longer time scales. PEAR experiments demonstrate the anomalous effect also in the direction of future. For instance, the experiments of Schmidt done 1992 discussed in New Scientist [J56] demonstrate that martial art students were able to affect the visual display determined by pre-recorded random numbers. The probability for this kind of deviations from non-randomness was about 1/1000. Henry Stapp proposed an explanation for this in his paper published in Phys. Rev. A [J53] based on nonlinear quantum mechanics.

The change of also geometric past in the quantum jump between quantum histories implies the notion of a four-dimensional physical reality and forces to regard three-dimensionality of reality as illusion created by the 3-dimensionality of our sensory experience (recall the notion of the association sequence). This implies that our geometric past is changing all the subjective time and that communications to the geometric past and future are possible and are consistent with the weak causality violation hypothesis of Schmidt [J52]. What this hypothesis implies that in the newest quantum history generated by RPK all separate records contain the pre-recorded random numbers are altered in the same manner in RPK. Schmidt has tested weak causality hypothesis by using two separate cassette tapes containing the pre-recorded random numbers, one used in the PK experiment and another one kept locked in a safe. The records were indeed found to be identical after the experiment.

The results of Schmidt suggest also classical signalling to the direction of the geometric past. Real space-time sheets with negative time orientation could serve as the geometric correlates for these signals.

### 2. *The work of Princeton Engineering Anomalies Research group*

The study of anomalies in human-machine anomalies provide a highly sophisticated and controlled manner to study psychokinesis in its various forms. For instance, in the experiments carried out in PEAR group (Princeton Engineering Anomalies Research) [J32] operators try to affect various kinds of electronic, mechanical, acoustical, optical and fluid devices. In unattended calibrations these devices yield random output whereas in the experimental situation operator tries intentionally to affect the output so that non-randomness results. Each input that operator tries to affect consists of 200 bits formed from a random physical signal and operator can have either the intention to increase the number of 1: s (high), the number of 0: s (low) or have no intention at all (baseline). Operators can exert their efforts from a distance of thousands of miles, before or after the the actual operation of the devices. Over the laboratory's 20-year history, thousands of such experiments, involving about 100 millions of trials, have been performed by several hundred operators.

The observed effects can be summarized as the average for the sum of bits which is 100.026 for high and 99.984 for low. The effect is by a factor 3.6 higher than the expected margin of error. Effects are thus quite small, of the order of a few parts in ten thousand on average, but they are statistically repeatable and compound to highly significant deviations from chance expectations. Effects are highly operator specific and there are significant disparities between male and female performances. The random devices respond also to the group activities of large numbers of people and are especially sensitive to the effect of small intimate groups, group rituals, sacred rites, musical and theatrical performances, and charismatic events.

Time mirror mechanism suggests the following model for the machine-human interactions encountered in say PEAR experiments.

1. The effect of intention could be on the generator of random noise, on bit sequence represented in the computer memory, or even on the recorded value of the sum of bits. A possible mechanism in the latter two cases is the reversal of electromagnetically represented bit.
2. The general mechanism of intentional action involves negative energy signals inducing a change in the charge distribution determining the value of bit. Negative energy photon could induce a dropping of ions to a larger space-time sheet. Also the emission of negative energy dark  $W$  bosons (appearing in TGD based model of nerve pulse) could induce a change in the

net charge. In both cases the sign of charge would correlate with the character of intention and for the first mechanism there would be asymmetry between “high” and “low” (proton, electron).

### 3. *The work of William Tiller*

[J87] [J87, J83, J84, J85] has performed experiments involving intentional imprinting of targets such as water. The model for the findings of Tiller is discussed in [K12]. The imprinting manifested itself as temporal and spatial oscillations of pH and temperature. The surprising finding was conditioning: also the air around intentionally imprinted device exhibited these oscillations. Also computer could be conditioned. The Fourier transform of the correlation function for bit sequences of random number generator demonstrated peaks at harmonics of  $f = 1/T$ ,  $T = 113.778$  min.  $2^n$ -multiple of 1 seconds for  $n = 16$  would correspond to  $k = 143$  and  $T = 109.23$  minutes which is by about 4 per cent too small. The proposed assignment of cyclotron photons with motor action leads to ask whether large  $\hbar$  dark cyclotron photons with these frequencies could induce a periodic perturbation of the random bit sequence?

### **Robots, chickens, rabbits and men**

The interaction between random number generators and humans or animals is one form of psychokinesis. For a few years ago the issue 62 of “Network”, the journal of the Scientific Medical Network [J77] contained a report about the experiments carried out by Dr. Rene Peoch, working at Fondation ODIER at Nantes. In these experiments chickens and rabbits apparently influenced signals composed by a random-number generator for a robot close to them, and human subjects apparently influenced the movements of the robot even though its signals had been generated by a random-number computer program six months earlier.

Chickens stayed close to the robot “imprinted” on it as their mother and followed it about. The robot had a random-number generator inside it controlling its movements, which checks showed to be truly random. The chickens were then removed and one placed so it could see the robot but could not follow it. Under these circumstances the robot spent measurably more time close to the chicken than away from it. The effect was that the chick was influencing the robot’s generator. The generator was then removed to a computer away from the experimental area. The same effect occurred. “Non-imprinted” chickens however had no apparent effect on the robot.

In the rabbit experiment, baby rabbits were frightened by the robot and kept away from it. When the rabbit’s movement was inhibited, the robot’s movements became non-random and it kept away from them. However, when one rabbit was starved and food was placed on the robot, this behavior was reversed and the robot brought the food to the rabbit. It was found that humans likewise could influence the robot.

Also humans were invited to influence the robot as before, but in fact it was being driven by a code generated six months earlier and recorded on a CD, now being played back. The robot was influenced as in the contemporary study. The CD was then examined and it was found that the first half of its code was indeed non-random, but the unused code was truly random. This gave the effect that the computer somehow “knew” six months earlier not only that half the code would be used for such an experiment, but also the general direction of the movements that would be required.

The interpretation of the reported results in terms of psychokinesis and human-animal-machine symbiosis suggests itself. The experiment with humans can also be interpreted as a dramatic verification for the prediction that in quantum jumps between quantum histories also the geometric past changes: the recent experiment suggests that the change occurred in a time scale of six months. If the crucial assumption about the randomness of the random number generator is correct, the effect is also very strong. This could mean that we are changing our geometric past all the subjective time in macro-temporal time scales, as indeed suggested by the paradigm of four-dimensional brain. A further suggestion is that this hypothesis can be indeed tested empirically by developing further these experimental arrangements.

To better comprehend what might be involved, recall that in TGD subjective time and geometric time are not one and the same thing. Accordingly, subjective memories are memories about conscious experiences and geometric memories are memories with respect to the geometric

time for which time is in a precisely same position as space: geometric memories give prediction of the future and past changing quantum jump by quantum jump like weather broadcasts (except that one usually is not interested in the predictions of what weather will subjectively be in geometrically last summer). The crucial point is that the contents of say computer files representing purely geometric memories (such as number sequences) can change in the quantum jumps whereas the possible subjective memories about their contents can remain unchanged. This peculiar contradiction between subjective and geometric memories, which I have christened as “tribar effect”, serves as a possible experimental test for the reality of notions of the subjective and geometric time. These experiments are bound to involve human memory as a subjective element: nothing however prevents several human subjects store to their memory the original memory to guarantee objectivity in a statistical sense.

If the randomness of the original random number series produced six months before the experiment involving human-robot interaction has not been checked, it can be argued that random number generators (if genuine) accidentally produced a number series which was not random in the time scale involved. This problem could be circumvented by modifying the experiment by checking already six months earlier whether the number series is really random or not. Humans can indeed remember whether the series is genuinely random or not although they are not able to remember long number series. On the other hand, if the non-randomization effect appears only under special conditions (effect is present for the imprinted chickens only), one has even without the check good reasons to believe that machine-mind interaction has occurred.

An important question of principle is whether the random number generators are genuine or whether the numbers are generated by some algorithm yielding only pseudo random numbers. If genuine randomness is due to quantum phenomena at atomic or molecular level, then intentional action could affect physics at atomic and molecular level. Of course, the success of p-adic mass calculation and interpretation of p-adic physics as physics of cognition forces the same conclusion. If some algorithm produced them and there is no noise affecting the outcome, the only changes which can occur is the modification of the algorithm or of the initial conditions for the algorithm. In the latter case the production of the desired behavior might however be impossible since the algorithm need not even allow the needed regular behavior of the random number sequence. This of course could be checked.

p-Adic space-time sheets representing intentions/memes should be transformed to their real counterparts realized as negative energy signals and able to interact with random number generators. If the p-adic memes are actually chicken’s intentions mediated by magnetic mirrors and transformed to real ones when intention is realized, the interaction mechanism is basically ordinary electromagnetic interaction with the machine. The question about the detailed mechanism allowing chicken’s volition to affect the geometric past of the robot allows endless variety of answers. The robot could have primitive consciousness, which the chicken can affect by generating negentropic entanglement. The robot could in fact become to some extent part of the chicken, kind of extended body. A signal proceeding to the geometric past and affecting the program coding the robot’s behavior could be also involved.

The results of experiments, if replicable, suggest that animal-machine anomalous interactions might be much stronger than human-machine interactions, perhaps because animal is totally confident that the desired interaction happens (Blessed are the meek since they will inherit the kingdom of Heaven!). One could imagine experimental arrangements analogous to the chicken-robot experiments in which the chicken is replaced by a human who genuinely believes that the robot can do what (s)he wishes: this could be achieved by telling the subject person that machine is programmed to deduce her/his wishes, from say EEG. Various modifications of the imprinting mechanism could be applied in more complicated situation. The results might be also used as guidelines in the attempts to generate artificial life. The systematic use of genuine random number generators as control tools of robotic motion suggests itself as a basic principle to guide the attempts to build artificial life. This would optimize the flexibility of the robot behavior so that it could be affected by p-adic intentions.

### **Adaptive robots as an electronic life form?**

The construction of artificial life by building initial value sensitive robots might be a possible breakthrough application of the p-adic cognition. What would be needed is just initial value

sensitivity: p-adic memes would take care of the rest.

Mark Tilden is a well-known builder of robots working in the nuclear physics laboratory of Los Alamos. Tilden builds his robots by using pieces of used electronics. The robots do not run any computer program so that the basic philosophy is more or less a diametrical opposite of AI. Rather, the wiring of the robots is such that in a new situation robot tries for different behaviors. For instance, if robot leg gets stuck, the robot changes the orbit of motion of leg. What is remarkable that the robots seem to behave like living organisms in some aspects.

Unfortunately, I do not have any scientific articles about Tilden's work apart from short description in his homepage [J14]. In fact, I encountered completely accidentally Tilden's work by reading an article in the Finnish version of Reader's Digest August 1998 after having seen Stetsoned Tilden and his tiny robots in a popular science program in Finnish TV telling about the recent situation in robotics, AI, and artificial life. The robots of Tilden have surprising abilities to adapt and compete for energy which they get from the sunlight. Robots seem to literally fight for the sunlight. For instance, an electronic fellow called Turbot, kills other robots from his territory and collects them to form a wall against the invasion of other invaders!

The claimed adaptive feats of these robots suggest that a primitive life form might be in question and this is also the belief of Mark Tilden. A general handwaving explanation for the adaptive behavior is that these systems are at the borderline between chaos and order and adaptive behavior "emerges". Of course, what "emergence" means is a complete mystery in the deterministic physics with quantum effects absent in macroscopic length scales.

That primitive life form might be in question, fits nicely with the TGD view. First of all, all forms of self-organization involve quantum jumps and consciousness, and the question is only how important is the role of cognitive consciousness in the behavior of the system. Cognitive consciousness can become important only if the system is sufficiently flexible and initial value sensitive so that the realization of intentional motor actions becomes possible by inducing critical perturbations to the initial-value sensitive behavior.

The in-built flexibility of the robot behavior (a strict opposite of pre-programmed behavior), and initial value sensitivity make in principle possible self-organization by quantum jumps and effective quantum control. For instance, robots could contain modules controlled by genuine random number generators which would be affected by p-adic memes. If p-adic physics is physics of cognition, Nature itself guarantees, that robots form cognitive representations, and by the flexibility of their motor system, they are able to transform cognitive representations to motor actions. If p-adic space-time sheets are indeed memes floating around and waiting for the opportunity to materialize themselves to action, the robots of Tilden could provide an excellent opportunity for a meme to reincarnate!

The extreme generality of the p-adic physics means that one cannot exclude the possibility that electronic systems could quite generally develop p-adic cognitive representations about itself. If so, can one guarantee that the old electronic components recycled by Tilden do not differ cognitively from electronic components coming directly from fabric? If they do, two identical robots built from old and new components might behave differently. Thus a test for whether the robots have mentality and some kind of developing personality is whether two physically identical robots behave differently under similar circumstances.

Quite generally, one can identify p-adic cognitive representations as the mechanism which gives the physical system personality and allowing to distinguish even between two electrons p-adically: of course, Fermi statistics does not allow a state consisting of two electrons in states differing only cognitively. Quite generally, this kind of test could be the counterpart of Turing test allowing to deduce whether physical system has cognitive self or not.

Also now negentropic entanglement and the universality of CD time scales raise the hopes that it might be possible to understand what is involved.

### Telekinesis and electrostatics

In the book "Mind at Large" edited by Tart, Puthoff, and Targ there is an article "An Investigation of Soviet Psychical Research" by Wortz *et al* reporting among other things the research related to the electrostatic aspects of telekinesis. The article mentions the work done by Vasiliev and associates with Nina Kulagina and the work of Adamenko with Alla Vinogradova, another highly gifted person in telekinesis. Kulagina and Vinogradova are said to have been able to move objects

of .1 kg along table. Interestingly, according to the article PK able persons tend to be women. Adamenko has tried to understand the phenomenon theoretically and has proposed that the static charges of objects and electrostatic forces generated by the subject might explain the effects.

#### Adamenko's work

The objects moved by subject persons were located at a table which was a di-electric cube with of side length of .5 meters in Adamenko's experiments.

1. Vinogradova was able to induce an electric charge in cube and then move objects located at the cube. With biofeedback training also other subjects were able to replicate Vinogradova's feat.
2. To move the object the static friction (friction coefficient between .1 and .3) must be overcome. Adamenko theorizes that there is kind of buoyancy force caused by the flow of air molecules involved and that the electric field somehow induces this force.
3. The reported electric field was 10 kV/cm and corresponds to the voltage at which a di-electric breakdown occurs in a dry air. The reported movement of the air could correspond to a corona wind resulting at strong electric fields.
4. Adamenko assumes that the objects had either static charge or that they were polarizable and developed a dipole moment in the external electric field. The electrostatic interaction with the electric field induced by Vinogradova would have been the cause of the movement.

#### TGD based model

TGD based model for phenomena is based on the general mechanism of mind-matter interactions allowed by the many-sheeted space-time concept. There are three questions to be answered: How the table and possibly also object were charged?; How the motion of the object was caused?; How the object was lifted from table to circumvent friction force? *How the table and object were charged?* The charging of the table is certainly crucial for the PK effect. Vinogradova could have emitted "topological light rays" (MEs), as a matter fact high frequency (microwave) MEs propagating like particles within low frequency (ELF) MEs. Negative energy ELF MEs could have served as correlates for entanglement. Entanglement is however not necessary in this case since conscious telepathy is not involved. Microwave MEs would have induced bridges between the atomic space-time sheets of the object and super-conducting magnetic flux tubes of Earth. The bridges would have made possible ionic and electronic currents between these space-time sheets and led to the charging of the table and possibly of also object. A suitable intentional targeting of MEs would allow to control the charge distributions of the table and object and therefore the pattern of the induced electrostatic fields.

*What could have produced the motion of the object?*

The interaction of the object with the electrostatic field of the table is a possible explanation for the PK effect. The distribution of the charges of the table and object would allow to control the field pattern and thus the direction of the electrostatic force. This is however not the only mechanism. Ionic currents from the magnetic flux tubes to the atomic space-time sheets of the object produce recoil effect (momentum is conserved only in many-sheeted space-time, not for single space-time sheet), and this could have been the fundamental mechanism of motion (essentially the mechanism of rocket motion). In both cases the subject would have produced only the ME bridges taking care of the control of motion but would not have provided the energy and momentum.

The experiments of Modanese and Podkletnov [H5] provide support for the mechanism. Modanese and Podkletnov studied capacitor at a rather low temperature and at a voltage near the di-electric breakdown voltage. The second electrode was a super-conducting disk. The resulting discharge was large and coherent and accompanied by radiation pulses of unknown type. The pulses induced the motion of the air and kicked test penduli. The force was proportional to the mass of the penduli. The effect caused by the pulses did not weaken with distance. This supports the view that the pulses were TGD counterparts of the Tesla's scalar waves realized as pairs of massless extremals with three momenta in different directions [K31] and induced temporary bridges



between test penduli and magnetic flux tubes inducing the flow of ions and the recoil effect. The same mechanism should be at work as a microscopic and incoherent version in the case of lifters.

*How to circumvent the friction?: a connection with the physics of lifters*

Lifters exhibit the called Biefeld-Brown effect [K103]. Lifters are asymmetric capacitors consisting typically of a wire electrode and planar electrode, are in a voltage slightly above the voltage causing di-electric breakdown. Lifters move in the direction of the smaller electrode. Also the flow of air from the small electrode to the large one is involved. On basis of the experimentation and guide the findings of Juha Hartikka, I ended up with a simple model of lifters. What would happen is that there is an electric discharge in the form of small plasmoids (discharge sparks would be analogous to ball lightnings), whose emission from the small electrode causes the recoil effect. The emission of the scalar wave pulses could induce the motion of the air by Modanese-Podletnov recoil mechanism. Since the table is charged, there should be a strong electric field also in the narrow space between the object and table. Therefore electronic discharges from the object could occur, and lead to a small scale lifter effect lifting the object slightly above the table. This does not require the object to carry a net charge.

#### **Could the remote EEG sensor of Sergeyev be based on the same mechanism as PK?**

In the same article also the remote EEG sensor invented by the mathematician Sergeyev claimed to remote sense EEG from a distance of 5 meters is described. Unfortunately, the information related to the invention of Sergeyev is classified. What is however known from the existing literature is that the sensor is surprisingly simple, consisting of a metal disk suspended into water and coated with a semiconductor. The immersion in water is reported to double the effectiveness of the sensor. According to the report, the ordinary EEG sensors can detect EEG only up to a distance of few centimeters since the noise of the environment masks the (Maxwellian) EEG at larger distances. Furthermore, the amplifying effect of water is not consistent with the high value of the di-electric constant of water if ordinary Maxwellian electrodynamics is behind the sensor.

Sergeyev's explanation for the functioning of the sensor utilizes bio-plasma hypothesis. The use of the term bio-plasma is remarkable since professional physicists know that plasma state at the temperatures and densities of living matter is not possible in standard physics universe. In TGD framework super-conducting ions leaking from the magnetic flux tubes of the Earth's magnetic field can give rise to what might be called bio-plasma, and Sergeyev's sensor is indeed said to produce bio-plasmagram. Also maser (microwave laser) effect in bio-matter producing ions and electrons flowing into air is mentioned.

All this suggests that EEG MEs containing microwave MEs inducing a leakage of the ions from magnetic flux tubes to the atomic space-time sheets of the metal disk and in this manner generate plasma. The strength of the resulting electric signal would be modulated by the intensity of the net flux of EEG MEs so that information about EEG would indeed result. EEG MEs would not topologically condense at atomic space-time sheets but propagate as bridges connecting the boundaries of the magnetic flux tubes and atomic  $k = 151$  (cell membrane thickness) space-time sheets. This would explain the dissipation free propagation. For positive energy MEs the effective phase velocity would be of the same order as the alpha wave phase velocity since these MEs would tend to "stuck" (in quantum sense). The basic sensing mechanism would be very much the same as explaining the generation of nerve pulse. Also  $Z^0$  MEs could be involved and would usually have a very weak interaction with the environment. The ability of water to act as a many-sheeted maser, presumably crucial for the functioning of living matter, could explain why the water amplifies the effectiveness of the sensor.

Also the remote sensing of the pulsating magnetic fields produced by Nina Kalugina and having strength nearly equal to that of the Earth's magnetic field are mentioned in the article. The possible significance of the pulsating magnetic fields for PK is still poorly understood in the TGD framework: the problem is that solutions of field equations representing this kind of field configurations are not known. One might however think that the pulsating magnetic fields carry also supra-currents, and that their presence intensifies the leakage of charged particles to the atomic space-time sheets of the remote sensor device.

### 2.4.3 Near Death Experiences

Near death experiences are rather commonly experienced, say by the victims of various accidents. These experiences are known for centuries but it was the best-selling book “Life after Life” of Raymond Moody which brought these experiences known to the general public [J76].

#### 1. *What NDEs are?*

NDEs seem to possess invariantly the same characteristic features. There are feelings of peace and joy, time speeded up, heightened sense, lost awareness of body, seeing bright light, entering another world, encountering a mystical being or deceased relatives and coming to a point of no return. The experiences seem to proceed in quite universal manner. First comes a loud buzzing or ringing noise and a long dark tunnel. Patient sees his own body from outside and does not feel any pain or agony anymore. Patient meets others and a being of light who shows his life in its entirety as a kind of playback to evaluate. Then comes the point of no return, and although patient feels peace, joy, and love, the patient has to return to continue his life. Often these experiences induce very profound changes in the subsequent life of the patient. The claims of Moody have been supported by subsequent research and hardly anyone, even the most foolhardy skeptic, denies the reality of these experiences.

The latest twist in the development emerged when University of Southampton research team announced the result of a one-year study of NDEs of victims of a heart attack supporting the view that consciousness and mind exist after the brain has ceased to function and the body is clinically dead. The resuscitated patients were various times clinically dead, with no pulse, no respiration and fixed dilated pupils. Independent EEG studies have confirmed that brain’s electric activity, and hence brain function (according to standard dogmas of neuro science) ceases in this kind of situation. 11 per cent of patients who survived the heart arrest however recalled emotions and visions during this state. This announcement has created considerable excitement in various consciousness related discussion groups and the question whether some of the basic dogmas of neuroscience are badly wrong has been raised by the neuroscientists themselves.

#### 2. *TGD based view about life after death very concisely*

It is good to summarize the latest TGD based view about consciousness after physical death before comparison with other theories and detailed analysis of NDEs. The view, which is certainly not the only possible one can imagine, is supported by the improved view about psychological time.

The basic notion is that of 4-D body involving both the physical body and the magnetic mirror structures associated with it. 4-D body is gradually carved like an artwork via phase transitions representing the progress of front of volition to the geometric future and by the reverse phase transitions deconstructing the 4-D body or its parts. This fractal trial-and-error construction of the 4-D body occurs in various time and length scales. Gradually increasingly stable 4-D body results. Volition can be seen as defining a front of phase transition so that the experience of 4-D body for which deconstruction processes occurs only in the time scales short compared to the duration of lifecycle, would be about entire lifecycle and in this sense “timeless”.

Contrary to the original belief, the phase transition associated with volition would not be p-adic-to-real phase transition but a state function reduction to the opposite boundary of CD meaning the death of the mental image representing intention and its re-incarnation about opposite boundary of CD. This reduction would involve a phase transition increasing the value of  $h_{eff} = n \times h$  and lead to the increase of negentropy in statistical sense. This increase would occur spontaneously since the transition would reduce quantum criticality and the subself representing the mental image about intention would fight to stay at former level criticality and to avoid death. All selves would do this and utilize for this purpose homeostatis and metabolism.

Since magnetic mirror structures are fundamental for the field realization of the genetic code, one can quite well consider the possibility that this process induces also the self-organization of the ordinary living matter around the magnetic mirror structures. This would have interpretation as a reincarnation. Buddhas able to resist the temptation to reincarnate would continue their life at the field level. Interestingly, the development of physics from Newtonian physics of the material bodies to Maxwellian physics of fields would mirror the evolution of consciousness from concrete biological life to life at the field level.

### 3. Astral plane theories for NDEs

There are several theories of NDEs. A theory enjoying popularity in New Age circles is based on the notions of the astral projection and next world stating that we have another body that is vehicle of our consciousness which leaves the body at the moment of death. Although completely respectable as such, this kind of theory is not based on existing or even postulated physics, and is therefore hard to test. The notions of “higher vibrational level” and “astral plane” are simply devoid of a physical meaning.

In TGD framework the idea about “vibrational levels” generalizes in an astonishing concreteness to an entire hierarchy of electromagnetic life forms and electromagnetic bodies whose sizes vary to astronomical length scales [K37, K77]. In this framework the idea about brain as a seat of consciousness is an illusion resulting from the fact that sensory data is mostly about the immediate region around body. Of course, even the idea that consciousness (as opposed to its information contents) can be localized to some part of space-time, is basically wrong in TGD approach.

A possible test for the astral projection theories is a weighing of the body after death to deduce the weight of the astral body (assuming of course that astral planes obey ordinary physics!). If “astral planes” correspond to the p-adic space-time sheets, this test of course does not make sense. Magnetic mirror structures are obvious candidates for astral body and are real but their separation from body is impossible so that this kind of measurements do not make sense. The notion of 4-D body also suggests that the physical body remain in the geometric past in the physical death wherefrom it can communicate with the living ones via the magnetic mirrors of magnetic body.

Extrasensory perception via astral bodies is a second possible test. This test might make sense if extrasensory perception can be generated by patterns of ELF em fields as supposed in the TGD inspired model of qualia. Magnetic mirrors connecting organisms to each other and also to “nonliving” matter make possible ESPs. Also direct electromagnetic perturbations of the magnetic sensory canvas can give rise to ESPs: in [K47] the possibility that the strange sounds produced by meteors [F3] could correspond to ESPs is discussed.

### 4. Tunnel experience

The theory of Grof and Halifax [J49] is based on the observation that NDE involves elements which might be assigned to the moment of birth. Perhaps NDE is reliving the moment of birth. The counter argument is that the newly born baby does not see anything unless she is able to perceive extrasensorily. “Nothing but hallucinations” theories are of course no explanations at all and belong to the same category as “consciousness as mere illusion” theories. In neuroscience framework also the wake-up reality is seen basically as a hallucination produced by brain and coupled with sensory input to guarantee correspondence with what is out there.

The tunnel is experienced also during epilepsy and migraine, during meditation and relaxed state of mind, and with certain drugs like LSD, philocybin and mescaline. I have also personal “tunnel experiences” every-daily: when I close my eyes in a half-meditative state achieved by writing at computer terminal, I can see a dim flow consisting of points. Typically this flow enters to or emergences from a tunnel. It can be rotating spiral like flow or simple sink or source. Source or sink can be also linear structure. Earlier this experience was not stable and tends to fade away all the time, and after few minutes I was not anymore able to achieve it. Situation has changed quite recently: I can have the experience almost anytime in peaceful state of mind. During my great experiences this flow was much more complicated and completely visible and formed a stable background of the ordinary visual experience and of hallucinatory visual images.

There is however no experience of entering into the tunnel in this case so that the tunnel need not be the same as encountered in NDEs. It has been suggested that the physiology of brain could explain the properties of near death experiences [J60]. The theory of Cowan [J60] states that the tunnel results from a failure of the inhibition leading to brain induced activity yielding visual experiences. What is however questionable is why person would feel falling into the tunnel, to say nothing about meeting deceased relatives. Blackmore and Troschienko have proposed a theory in which also the motion along tunnel could be understood as a visual illusion [J25].

TGD based explanation for tunnel experience might be simply as a direct visual experience about magnetic flux tube structures resulting from the perturbation of the magnetic sensory canvas

outside body. Thus a genuine ESP would be in question. Magnetic field obeys indeed same basic equation as incompressible liquid flow. Both retinas and pineal gland (“third eye” literally since it contains retinal pigments and serves as a genuine third eye in some species [K37] are magnetic structures. The practically always present vortex in center (“third eye” in my private terminology) could correspond to the magnetic flux tube structure emanating from the pineal gland whereas the very dynamical flow could correspond to the contribution of retinas. If the magnetic mirrors are universal electromagnetic bridges connecting us to other living beings, in particular to our friends and relatives, the meeting of the 4-D bodies of the deceased relatives would happen at the level of fields.

The movement along the tunnel could correspond to s propagation along this kind of magnetic mirror structure transforming it from p-adic to real: thus the tunnel would be created after the physical death. During lifetime these em bridges would be p-adic and physical death be followed via the transformation of these bridges to real ones.

### 5. OBE aspect

Blackmore explains OBEs [J80] as resulting from the replacement of ordinary self-center experience of world with bird’s eye of view model where brain sees own body from above. Bird’s eye of view is only a memory model so that extrasensory perceptions are predicted to be impossible during OBEs. There is however some evidence that patients can report very precise visual perceptions during OBE. It has been indeed argued, that some other senses than vision, namely [K73] [J80], could create indirectly these perceptions. It is however difficult for even the most hardborn materialist to understand how a clinically dead person could be able to effectively see by hearing, since this feat is impossible for even completely healthy person.

The idea of Blackmore about bird’s eye of view is very attractive as such and can be interpreted in TGD framework in quite different manner. Cognitive maps based on the canonical identification map [K36] typically exterior to inside and vice versa. Thus both a p-adic map of the external world realized inside brain and a p-adic map of body and its surrounding realized outside the body are possible and would give models of the external world and self. The inside-to-exterior map could provide a bird’s eye of view about body and its immediate surroundings.

Both exterior→interior and interior→exterior maps could contribute to the conscious experience even under the normal wake-up consciousness and the exterior contribution would thus represent genuinely extrasensory contribution to the conscious experience. When the ordinary sensory input and volitional activity ceases as during NDE, the contribution of the model of external world to the conscious experience becomes negligible. The ability to experience tunnel unstably during relaxed wake-up consciousness with eyes closed is consistent with the interpretation that these two components are competing. It is quite possible that during sleep the bird’s eye of view component also dominates but that no memories about this period are generated for the simple reason that the brain functions necessary for the generation of the memories are not active. My own remembrances about the long depressive period after the great experience caused by the extreme dullness of the normal wake-up consciousness suggest at least to me that these kind of memories might make it too painful to continue the daily life.

The notion of magnetic sensory canvas implies that we actually see at ELF frequencies. Same applies to other senses. This implies the possibility of experiences without any sensory input or even without any neuronal activity. The needed ELF MEs acting as sensory projectors would be generated in the dropping of ions from atomic space-time sheets to the magnetic flux tubes of magnetic body carrying field strength.2 Gauss (Earth’s magnetic field has nominal value.5 Gauss). If the ion drops in high  $n$  cyclotron state the subsequent decay of the state by cyclotron transitions generates a bundle of parallel ELF MEs giving rise to the sensory projection. This representation can be generated by the entire body and would give rise to a three-dimensional vision about body as seen by the environment. There is some evidence for this kind of anomalous vision.

1. Yogis have reported altered states of consciousness in which they see their own body three-dimensionally, that is simultaneously from all directions.
2. Becker tells in his book “Cross currents” [J78] about a young cancer patient who told that he can see the interior of his own body. The patient could locate the calcium deposit left as tumor vanished. This supports the view that ELF MEs could project from the entire body to the sensory canvas.

3. Also the OBE experiences, for instance those associated with NDEs, could have a similar interpretation. The sensory input from eyes and even the input from neural activity could be absent during NDEs so that the visual experience should be determined by the background ELF component emanating from the brain and body. The third person perspective associated with OBEs might be always present but be masked by the strong sensory input.

What has been said applies also to other senses. Interestingly, I often wake-up partially and realize that I hear my own snoring as an outsider. Sometimes I have an experience which might be interpreted by saying that the hearing in the first perspective is superposed with the hearing in the third person perspective. The third person hearing has a time lag so that a kind of double breathing results.

Sensory canvas hypothesis provides a more concrete view about the situation. p-Adic-to-real phase transition of a p-adic magnetic sensory canvas to real one could also be part of the fundamental volitional process. The magnetic mirrors connecting brain to sensory canvas should be there also in the absence of sensory input. Could it be that the out of body view is always involved but masked by the from the body view and after the physical death only out of body view remains?

The competition between bird's eye of view and sensory view has also EEG correlate. Delta waves in the EEG spectrum are natural EEG correlates for the external part of cognition. The reason is that this part of EEG frequency spectrum has a shape and intensity very similar to that for the so called sferics [F1], which correspond to meteorological electromagnetic perturbations typically associated with thunder storms. Could sferics be the electromagnetic correlates of disincarnates?! The degree of the sensory alertness correlates directly with the ratio of the EEG net intensities in the delta band and in higher EEG bands [F1]. This is consistent with the competition predicted by NMP. Certainly in the NDE experiences studied by the Southampton team only delta band is present in EEG. Note that delta waves dominate also during deep sleep.

Also alpha band is a good candidate for communicating sensory information to higher level selves having magnetic sensory canvas receiving sensory input from several brains simultaneously. It is indeed alpha band in which detectable changes occur in remote vision and remote healing [J65]. Could it be that higher than alpha consciousness somehow transforms to alpha consciousness in physical death and could it be that alpha consciousness relates with the fact the lowest Schumann frequency associated with the perturbations of Earth's magnetic field is in the alpha band? It might be that magnetic transition frequencies are involved with the "vertical" communications from brain to the sensory canvas whereas Schumann resonances would be involved with the lateral communications between different sensory canvases. The fact that hypnagogic experiences involving also identification with other persons (personal experience) appear in the borderline between wake and sleep when dominating EEG frequencies are around 7.8 Hz supports this view.

#### 6. *Life review*

Blackmore explains the life review as an effect analogous to the lively episodal memories generated by stimulating temporal lobes. This explanation leaves open what exactly happens in the stimulation of the temporal lobes and what episodal memories are. To say nothing about the systematic review and evaluation.

In TGD framework brain and perceptive field are four-dimensional and it is quite possible that episodal memories are multitime experiences involving input which comes from the moment of the geometric time when the recalled experience happened and happens again at the level of sensory representation but not as real life event since this would involve macroscopic volition and induce miracle life events in the geometric future. The notion of 4-D body makes this idea concrete. In the physical death 4-D body becomes in some sense mature (about possible de-construction processes in shorter time scales). The volitional contribution essential for the illusion that world is 3-dimensional is not anymore present and entire 4-D body is experienced as a whole. Perhaps this is just what life review is.

Since geometric memories are in question, the review is only a narrative since our geometric past changes all the subjective time and the review is about geometric past subjectively now. Life review would be a temporal counterpart of the OBE experience in the sense that one sees one's geometric life history from outside in a 4-dimensional sense. This is possible since p-adic cognitive representations are four-dimensional and four-dimensional bird's eye of view could begin

to dominate at the moment of death.

Also genuine subjective memories about time interval equal to the wake-up period of self and of order lifetime could be in question. This requires the occurrence of what might be called a p-adic phase transition to higher level self with much longer subjective memory: this view is in accordance with the vision about the physical death as a birth to a life in “other world”. p-Adic phase transition could mean that the p-adic magnetic mirrors after the geometric time after physical death correspond to higher value of  $p$  and quite concretely, have lengths which are longer than during the physical life. This makes possible both geometric and subjective memories in much longer time scale.

### 7. Positive emotions

With the motivation coming from the OBEs associated with the temporal-lobe epilepsy, it has been suggested that brain-stress near NDE episode leads to the release of neuropeptides and neurotransmitters (in particular endogenous endorphins) which are responsible for positive emotional states like joy, peace, and love. Again the question concerns about the deeper mechanism. Presumably these neurochemicals are only correlates for the experiences in which extra-sensory component of the experience begins to dominate. It has been also suggested that the lack of oxygen is what gives rise to the NDE experiences [J80]. The observations of the Southampton team seem to exclude these explanations. Of course, one could claim that some core parts of brain are working even when the patient is clinically dead (no respiration, no heart beat, dilated pupils) and that these functioning parts of brain are able to generate NDE. If so, spiritual experiences would represent the lowest possible levels of consciousness, and even reptiles would have them: perhaps a vulgar skeptic could applaud here but I do not find this idea very convincing.

In TGD framework clinical death naturally implies that extrasensory component of the conscious experience begins to dominate. This picture is consistent with the view about brain as builder of complex cognitive representations rather than the seat of the entire conscious experience. The dominance of the positive emotions would simply mean that the negative emotions coming from sensory input would be absent.

Note that in adelic vision the cognitive representations and sensory representations are aspects of one and same thing - real and p-adic variants of preferred extremal associated with by the strong form of holography to string world sheets and partonic 2-surfaces in the intersection of reality and p-adicities - and complexity for cognitive representations corresponds very closely to complexity for sensory representations. There are no thoughts in vacuum! One could even say that cognitive representations are determined by matter as materialist believes. Materialist’s world view cannot of course include intentional actions.

### 8. Other worlds

The experiencing of “other worlds” requires a considerable amount of hand weaving in the standard neuroscience framework. Blackmore claims that imagined worlds are experienced as real because these experiences are the most stable. I believe that Blackmore is right in the sense that mental images (sub-selves) correspond to self-organization patterns which are stable asymptotic states of self-organization. I do not however believe that this is an essential point, and certainly Blackmore’s explanation fails if the interpretation of the Southampton team about NDEs is correct.

In TGD framework the other worlds might correspond to the emergence of magnetic mirror structures which correspond to higher value of p-adic prime than during the physical life. They would have much longer lengths and give rise to much longer subjective and geometric memories. Note that the MEs associated with magnetic mirrors are classical representation for light (which brings in mind Tibetan book of death!) so that one could say that the deceased becomes a light being in a well-defined sense. The meeting of the light being might mean an ability to communicate with and sensorily experience the presence of other light beings, natural if the deceased herself has transformed to a light being (but having still 4-D body in the geometric past, this is perhaps why angels have human body!).

Note also that the absence of sensory and corresponding cognitive mental images during NDE is analogous to the empty mind free of mental images which is the goal of the meditation practices. Perhaps soul could be identified as a self having no sub-selves, “irreducible self” as suggested in [K82].

### 9. After effects

The after effects induced by the spatio-temporally extended consciousness in which one sees one's own life from outside are often dramatic. It is difficult to reduce these after effects to brain pharmacology.

My own great experience had many aspects common to NDEs and induced profound (not at all pleasant!) changes in my own life. In my case the direct experience of the higher levels of reality made possible the realization how magnificent the almost-boring everyday reality really is when seen through sharpened senses, how pathetically narrow the zone of wake-up consciousness is, and how ridiculously little the celebrated big science tells about reality. This realization resulted in a strong conviction that I am on a right track, and has given the courage to work these fifteen years as a ridiculed scientific dissident in a country in which vulgar skepticism is in the role of a scientific state religion and vulgar skeptics have taken the role of the mind police of science.

### 2.4.4 Are Communications Between Living And Deceased Possible?

The vision about psychological time suggests that the life after the physical death could be purely electromagnetic so that the memes and memplexes represented by p-adic cognitive space-time sheets (magnetic mirrors say) associated with the organism continue to transform to their real counterparts after the physical death. Since these magnetic mirrors can connect the 4-D body of the deceased to living physical bodies, communications between deceased and living become possible and the mechanism of communications is same as the mechanism of long term memories. It is also possible that the transformation of the magnetic mirror structures to real form induce generation of biological organisms around them and this would give rise to re-incarnation.

In the language used in the spiritistic circles, 4-D bodies of the deceased together with the magnetic mirror structure associated with them also after the physical death would correspond to “discarnate” or “ethereal” entities belonging to the “etheric level”. Perhaps the proper interpretation for p-adic space-time sheets representing thoughts and intentions is as not-yet-born entities.

Since the p-adic copies of all real physical systems are possible, even the most far-fetched claims of psychics about materialization and communication phenomena could in principle make sense. It however seems that what is materialized by is the plan for organism represented by magnetic flux tube structures around which visible matter self-organizes.

### Mediums and materializations

In spiritualistic circles mediums have been traditionally seen to mediate communications between deceased and alive. This includes also claimed materializations of physical objects besides the bodies of the deceased. Often direct voices emerging from empty space are claimed to be heard during the sittings: trumpets and accordions flow in the air and produce music. Analogous direct voice phenomena are associated with the claimed poltergeist phenomena. The explanation goes that medium is able to somehow to draw “ectoplasm” from her (quite often her) own body and from the bodies of the participants which then materializes as the bodies of deceased and as material objects.

For a physicist this explanation is empty as long as a physical and mathematical definition of the ectoplasm is lacking. In TGD frame work mediums could be seen as persons able to act as relay stations communicating with both deceased and with the participants of the sitting via magnetic mirror bridges. Perhaps these bridges are generated during sitting and medium helps to transform them to real form so that communications along these bridges become possible. The transformation of the p-adic space-time sheets to real ones is of course the natural candidate for the materialization process.

Zero energy ontology allows also a direct generation of CD in quantum jump is in principle possible and TGD inspired theory of consciousness support this possibility indirectly since the generation of a mental image corresponds to generation of sub-CD and thus creation of zero energy state from vacuum. In this framework ectoplasm would be ordinary biomatter.

My own great experience, which involved several parapsychological elements, was a parade of deep ideas, and one of them was the notion “flogiston” as something new for the existing physics and absolutely essential for the living matter. According to the vision, living organisms were fighting

and killing to get “flogiston”, and the greatest minds had been able to get it (even steal!) more than the lesser souls. I have considered several identification of this mysterious “flogiston”. p-Adic space-time sheets is one possible identification. Second interpretation as negentropic entanglement possible in the intersection of real and p-adic worlds and crucial for TGD inspired view about metabolism.

One cannot exclude the possibility that the transformation of the plan for a material body represented by magnetic mirror structures could induce a self-organization of the ordinary matter around this template to form material objects or at least mimicries of them. This is essentially what biological growth is assumed to be. The intersection of real and p-adic worlds would provide a concrete realization of this mimicry.

The claim is that this kind of materializations take place in spiritistic sittings. To my opinion, what happens is generation of hallucination like experience rather than genuine materialization. Usually the spiritistics sittings have been held in the darkness and this allows excellent opportunities for a fraud. On the other hand, alpha band in EEG begins to dominate in darkness and might make possible the communications. There are several reasons to think that it is fast amplitude modulation of alpha frequencies producing harmonic multiples of the alpha frequency, which could be the communication mechanism between our level and higher levels of self hierarchy. The so called mesoscopic features appearing in EEG correlates and corresponding to 1-2 cm areas of cortex [E2] could be direct physical correlates for these communications [K77]. The model of bicameral mind based on the notion of semitrance relies on the same idea [K83]. Note that the minimization of the sensory input (sittings are arranged in dark room) might be just what is needed for the extrasensory input to dominate.

### **EMDR method as a mechanism to communicate with deceased**

Near-death experiences are not the only manner to get convinced about life after death. So called eye-movement de-sensitization and reprocessing (EMDR) discovered by Francine Shapiro [J18, J48] induces what could be interpreted as after-death communications. The experiences of subject persons can be induced by this therapy in highly reliable manner: according to [J18] 98 per cent of patients willing to participate the therapy had after death communication experience. It does not matter what the religious convictions of the subject person are and the experiences are actually rather easy to induce. It does not matter if the loss is traumatic or not or whether it is recent or occurred for decades in past. The experiences resemble near death experiences (light tunnels, beautiful landscapes) and involve spiritual contact with the deceased. The EMDR technique involves getting the patient to move his or her eyes in a particular rhythmic fashion while at the same time attending to a particular aspect of the traumatic memory. How EMDR works is poorly understood as yet: possibly the fact that the shifting of eyes leads to increased brain processing is of importance. Notice that rapid eye movements REM are also involved with dreams.

A possible explanation is that EMDR experiences could involve communication with the 4-D bodies of the deceased ones located possibly in the geometric recent or past via the magnetic mirrors associated with them. One might think that rapid rhythmic eye movements induce fast modulations of some alpha frequency and generate the above mentioned features which somehow help to get a contact with deceased, perhaps rhythmic eye movements somehow generate the negative energy MEs generating the contact to geometric past. Essentially the same mechanism as involved with long term episodal memories would be in question: the only difference would be that the magnetic mirrors now mediate information not from own 4-D body from the 4-D body of the deceased.

## **2.5 TGD Based Model For Instrumental Transcommunications**

### **2.5.1 Introduction**

The so called instrumental transcommunications (ITC) and electronic voice phenomena (EVP) [J75, J61] belong to the borderline of even paranormal phenomena, and skeptically oriented scientists probably find it rather difficult to take the claimed phenomena seriously. Personally I do not



have any strong opinions and I am just interested in finding whether TGD view about paranormal phenomena might allow the claimed phenomena. Quite generally, ITC can be defined as messages communicated by some conscious entities other than humans using various kinds of electronic instruments. Electronic voices (EVP) are only a special case of the claimed communications and can be realized as signals appearing in a magnetic tape, as voices heard directly from radio receivers, or even phone calls from dead. Also images appearing in a computer screen are reported. The article of Ralf Determayer in the ITC journal [J75], whose chief editor Anabela Cardoso is also ITC experimenter, helps to get an overview about the ITC phenomena.

Friedrich Jurgenson is usually mentioned as the pioneer of EVP. In 1959 Jurgenson recorded bird song in the morning to a tape recorder and to his surprise found that the tape contained also something else. He started a systematic research of the voices which he interpreted as messages from deceased. This work materialized in two books, “Voices from Space” and “Radio-link with the Dead”. Kostantin Raudive, professor of philosophy and psychology and a student of Carl Jung met Jurgenson in 1965, got interested in the phenomenon, and started an intensive recording and study. He published his results in book “Breakthrough” [J61]. As a matter of fact, Jurgenson and Raudive had predecessors, Raymond Bayless, Attila Szalay published 1959 an article about the phenomenon in Journal of the American Society of Psychological Research, few months before Jurgenson made his discovery. Later begun experimenting also with other forms of EVP and ITC [J75]. EVP involves recorded phone calls from deceased, direct radio voices, voices both heard by experimenter and tape recorded, and “paranormal” voices not heard but recorded. ITC involves also other communication modes such as reception of images via computer screen. If one takes seriously all these reports, it would seem that both analog and digital communications are involved.

### **EVP and ITC very briefly**

My own knowledge about EVP and ITC is very restricted. According to the articles published in ITC journal, for instance the articles [J75, J73, J72] there seems to be a consensus about the following aspects of ITC.

1. The role of the experimenter is important. The ability to receive messages is learned only gradually. The receiving system which works for one experimenter does not work for another. For instance, if two radios are used simultaneously they usually work at different frequencies. This all suggests that experimenter serves as a kind of medium, relay station, or “radio link”.
2. The naïve idea about spirits serving as radio stations is not probably correct [J73, J72]. The voices from radio receivers tend to be located in silent periods containing only the background noise and somehow the sender is able to use the energy of the noise to generate the message. This suggests that stochastic resonance in which a weak signal is amplified using noise to provide the energy might be involved. The transformation of noise to voice raises the question about the possible breaking of the second law of thermodynamics, and TGD indeed allows breaking of second law below p-adic time scales [K43].
3. The spectral analysis of the electronic voices by Paolo Presi [J72] shows that usually the voices have an acoustical structure similar to that of human voices. The temporal sequence of vowels, their duration, the duration of the pauses, and the accent of certain vowels of the voices determine a speech rhythm similar to ours. The transfer of information is based exclusively on the sequence of the vowel formants and the integration, made by listener, of the missing consonants. Consonants are produced by a sudden interruption of the air flow coming from the lungs or by an obstruction of the vocal tract. The spectrograms contain no fundamental frequency [J73, J72] unlike speech for which the fundamental frequency defines the pitch. In principle this does not mean a loss of information but together with the absence of the consonants would mean that the primary source of the message is probably not speech organs. This makes hoax as an explanation of the voices less plausible.

### **Questions**

There are several questions to be answered. 1. *How could one tell whether the ITC messages are real or not?*

Brain tries to generate standard percepts from sensory inputs: by looking at clouds at the sky one realizes that brain almost inevitably tends to see faces or other patterns. Therefore this question is highly non-trivial. One can try to answer the question by analyzing whether (say) the electronic voices have spectra resembling that of human voices, and carry the minimum information to be recognized as a speech. It is relatively easy to distinguish an artefact produced by an intelligent life-form (say quartz clock) from a “dead” matter (say a piece of rock). In the similar manner, the differences between the electronic voices and “dead sounds” provide a criterion for whether they are produced intentionally. The information content of the signal is an obvious criterion for this but it is far from trivial, how to define and measure the information content.

Standard real-number based statistical physics allows only the notion of entropy. Entropy is always non-negative so that the information defined as negentropy would be non-positive always: the best one can achieve would be to know nothing! TGD inspired theory of consciousness strongly encourages a number theoretic modification of the standard notion of information, which is based on Shannon’s definition of entropy [K52]. The resulting p-adic entropies (one for each prime p) obey the same axioms as the Shannon’s entropy but can have both positive and negative values, and depending on the sign can be interpreted as measures of either dis-information or information. These information measures might apply to the analysis of EVP messages. The conclusion of Paolo Presi [J73, J72] on basis of his analysis is that the voices represent a real attempt to communicate. In the following I will assume the messages are real and look whether TGD based view about remote mental interactions allows to model the phenomenon.

### 2. *What could we speculate about the senders of the messages?*

In TGD Universe everything is conscious and consciousness can be only lost by quantum entangling. Thus everything is living, and the question is only about how effectively system can control its own state and the state of its environment and about the time scale of the control.

1. Ordinary humans could send these messages unconsciously: human brain and body act as both receiving and sending electromagnetic antennae and in view of the topological quantization of classical em field, it would not be too surprising if these electromagnetic messages could be received electronically under some conditions.
2. TGD predicts that our electromagnetic bodies will survive so that the conscious experience of a discarnate receives a contribution from the 4-dimensional body of the deceased (life review reported in near death experiences) plus a contribution from electromagnetic body still existing.
3. Also the magnetosphere is predicted to be a conscious entity containing collective multi-brained selves.
4. The model for crop formations [K26, K27] leads to rather detailed ideas about exotic life-forms residing at various boundary layers of the magnetosphere, where energy currents driving self-organization are strong. In particular, the mantle-core and core-inner core boundary layers are good candidates for the seats of lifeforms (intra-terrestrials, ITs) quantum-controlling the liquid and/or liquid-crystal phases of quartz or iron from very cold and super-conducting space-time sheets.

3. *What is the communication mechanism?* TGD based model of remote mental interactions is based on same mechanism as communications inside biological organisms. The mechanism involves quantum entanglement having low frequency MEs (massless extremals, “topological light rays” ) as a space-time correlate, and remotely induced self-organization based on high frequency MEs propagating along low frequency MEs like mass-less particles. If magnetic mirrors act as bridges between the deceased and the experimenter and between the experimenter and the electronic instrument so that the experimenter takes the role of a relay station (or medium), the phenomenon ceases to look totally implausible. Long term memory, telepathy, remote healing, ..., and communications with exotic life-forms and deceased become special cases of the same general phenomenon. For instance, TGD predicts mechanisms for how body and brain seem can act as lasers in wavelength range extending from ELF range to visible and UV wavelengths. This kind

of laser action could amplify the incoming signal, say microwaves at GHz region, which could be detected in turn by the electronic instrument with which the experimenter has quantum entanglement bridges, and then transformed to sounds.

4. *How the sender can handle modern information technology to generate the desired messages?*

In case of a tape recorder or telephone the electric signal is only em variant of sound wave but in case of radio situation changes. The carrier frequency of the sound changes and amplitude modulation can be replaced with frequency modulation. If signal is to be transformed to visual images, a transformation to binary code is needed. The question is where this technological knowhow comes? There are two possibilities.

1. A feedback from the electronic instrument via the brain of experimenter listening say the magnetotape and thus trial-and-error learning of how to send desired messages becomes possible. The simplest feedback is based on the sharing of the mental images of the experimenter by quantum telepathy. TGD allows also history editing, which means that the message to the instrument in the geometric past is modified again and again so that a repeated listening of the message could make it more comprehensible.
2. The existing knowledge about remote mental interaction suggests that they often involve magnetospheric multi-brained selves acting as kind of relay stations. For instance, remote viewer knows only the coordinates of the target, which as such are completely meaningless numbers to her: it is enough that the person who gave the coordinates of the target to the viewer knows their meaning. If ITC occurs in this manner, the information about how to translate the message to say bit sequences in the computer memory might be available. A direct remote mental interaction with the electronic system might be involved at least in some cases and the question is how the proposed general scenario allows to realize this.

5. *How the intention of the sender is realized as action?*

Remote mental interactions involve also the transformation of intention to action. In TGD framework this corresponds to p-adic-to-real transformation for some space-time sheets. Natural candidates are systems for which the energy of the resulting real system is small so that external energy feed can provide it. If the primary message comes from the magnetic body of the deceased, p-adic MEs are perhaps the most natural candidates for the representations of intentions. These p-adic MEs must first be transformed to real MEs; the real MEs interact with the magnetospheric self; the real MEs originating from the magnetosphere interact with the brain and/or body of experimenter, which in turn interacts with the receiving instrument.

Detailed models for the transformation of the p-adic ME to a basic signal (represented by light or sound) or directly to an electric signal (say in magnetic tape recorder) are not possible at this stage. The mere occurrence of this transformation involves an active volition, and here the role of the experimenter who believes and wants that the transformation occurs, might be decisive. If this is the case, the phenomenon might be also regarded as a particular form of psychokinesis and disappear if the experimenter has a skeptic attitude. Also feedback via the brain of the experimenter to the sender is required and is strongest when the experimenter listens or sees whether the message is there and possibly recognizes it.

### 2.5.2 Universe As A Conscious Hologram And A General Mechanism Of Remote Mental Interactions

The idea about brain and perhaps all bio-matter, and even Universe, as a hologram in some sense (see for instance, the articles of Miller and Webb [J68] and of Gariaev *et al* [I17] ) has a long history but the question in which precise physical sense this holds true has remained without a satisfactory answer. The notion of conscious hologram provided by TGD approach allows to understand bio-control and remote mental interactions as particular cases of the same basic interaction. The notion of conscious hologram leads also naturally to the notions of magnetic body and magnetospheric sensory representations.

### The general model of remote mental interactions

The mechanism of remote mental interaction involves two parts. The entanglement, which made possible by low frequency ME in even astrophysical length scales, means that sender and receiver of the message become effectively a single system. This is enough to explain remote viewing as sharing of mental images implied by the fusion of mental images of viewer and target system. The active remote realization of intention requires high frequency MEs propagating like mass-less particles along the low frequency ME and inducing the leakage of the supra currents from larger to smaller space-time sheets, dissipation and possibly also amplifying laser action. This mechanism works also in ordinary bio-control: remote mental interaction is now between some biostructures such as cells or organs.

The scaling law of homeopathy, stating that high and low frequency MEs accompany each other and the frequencies are in some fixed proportions, plus p-adic length scale hypothesis make the hypothesis highly predictive. There is no need to emphasize that the reduction of both homeostasis and remote mental interaction to the same basic mechanism gives support for the reality of the remote mental interactions.

### The notion of conscious hologram

The concrete Maxwellian idea about hologram plate resulting as a result of interference of the reference beam and light scattered from an object can serve only as a guiding metaphor. First of all, coherence occurs only in what are called coherence regions and the problem is that Maxwellian theory does not really provide a first principle definition for the coherence regions. In quantum theory similar problem is encountered. Secondly, in living matter it is not at all clear whether reference beam exists at all. Third, living matter is a dynamic granular structure and far from a homogeneous hologram plate. Fourth, the idea about storing memories, one of the basic motivations of the hologram paradigm, has its own problems although multi-holograms are certainly possible.

In TGD framework topological quantization provides a precise first principle description of coherence. Topological field quanta are the coherence regions of the classical field and classical de-coherence means the splitting of the space-time surface to topological quanta. This process gives rise to the granular structure of matter and space-time sheets in various length scales are excellent candidates for basic units of hologrammic structures at the this level of the p-adic length scale hierarchy. At quantum level bound state quantum entanglement having join along boundaries bonds as a space-time correlate is responsible for the macroscopic and macrotemporal quantum coherence. The notion of conscious hologram combines two dual aspects of consciousness to single concept: macrotemporal quantum coherence due to the generation of bound state entanglement and giving rise to co-operation on one hand, and the dissipative self-organization giving rise to Darwinian selection and competition on the other hand. In nutshell, the notion of conscious hologram follows from the topological field quantization.

1. Classical fields and matter form a Feynman diagram like structure consisting of lines representing matter (say charged particles) and bosons (say photons). The matter lines are replaced by space-time sheets representing matter (elementary particles, atoms, molecules, ...), and virtual bosons are replaced by topological light rays ("mass-less extremals", MEs). Also magnetic flux tubes appear and together with MEs they serve as correlates for bound state quantum entanglement.
2. The classical fields associated with MEs interfere only at the nodes, where they meet, and one has a hologram like structure with nodes interpreted as the points of a hologram. Thus one avoids the loss of information caused by the interference of all signals everywhere. This aspect is crucial for understanding the role of em fields in living matter and brain. The MEs corresponding to "real photons" are like laser beams entering the hologram and possibly reflected from it. What is new that the nodes can be connected by "virtual photon" MEs also analogous to laser beams. Hence also "self-holograms" with no laser beam from external world are possible (brain without sensory input). The hologram has a fractal structure: there are space-time sheets at space-time sheets and high frequency MEs propagating effectively as

mass-less particles inside low frequency MEs serving as quantum entangling bridges of even astrophysical length.

3. The particle like high frequency MEs induce “bridges” between magnetic flux tubes and atomic space-time sheets at the receiving end. This makes possible the leakage of supra currents from magnetic flux tubes to atomic space-time sheets analogous to the exposure of film producing hologram. The leakage induces dissipation, self-organization, and primitive metabolism as a cyclic flow of ionic currents between the two space-time sheets, and thus a Darwinian selection of the self-organization patterns results. The low frequency MEs are responsible for the bound state entanglement, macroscopic quantum coherence and co-operation whereas high frequency MEs are responsible for self-organization and competition.
4. Also the notion of laser action finds its place: many-sheeted space-time provides natural mechanism of laser interaction: when the system is irradiated with coherent light with a frequency which corresponds to the energy difference for the ions at the space-sheets corresponding to different p-adic primes, induced dropping of the ions to a larger space-time sheet occurs and implies a stimulated emission. Thus the light beam can be amplified.
5. At the level of conscious experience the fusion of sub-selves gives rise to a fusion of mental images. In case of right and left visual fields this fusion gives rise to stereovision analogous to what results in hologram. In the general case kind of stereo consciousness results if the mental images are sufficiently similar.

In many-sheeted space-time particles topologically condense at all space-time sheets having projection to given region of space-time so that this option makes sense only near the boundaries of space-time sheet of a given system. Also p-adic phase transition increasing the size of the space-time sheet could take place and the liberated energy would correspond to the reduction of zero point kinetic energy. Particles could be transferred from a portion of magnetic flux tube portion to another one with different value of magnetic field and possibly also of Planck constant  $\hbar_{eff}$  so that cyclotron energy would be liberated.

### Magnetic sensory canvas hypothesis

The magnetic sensory canvas hypothesis is perhaps the most radical hypothesis of TGD inspired theory of consciousness. It states that sensory representations are realized outside brain at magnetic flux tube structures associated with brain and have sizes measured perhaps in the size scale of Earth. The realization is based on the same mechanism as remote mental interactions: the simple feeling of existence mental images fuses with the more complex mental images produced in brain.

Possible extra-sensory perceptions induced by atmospheric phenomena might provide support for this hypothesis. Auroras are known to induce sounds not detected by electronic means: could these be extrasensory perceptions induced by auroras on sensory canvas. Also meteors could induce sounds [F3]. If one takes very seriously the model for sensory representations, one can imagine that the meteors could kick electromagnetically the magnetic flux tube-ME pairs of sensory canvas and force them to resonantly oscillate at harmonics of the thalamocortical resonance frequencies in interval 37-44 Hz.

These magnetic mirrors might also mediate the electric perturbations to Earth in a channelled manner so that no attenuation would be involved. The mirrors could mediate un-attenuated or even amplified ELF waves also also to electronic instruments. And what is of special interest now, if electronic instruments couple to the magnetic sensory canvas, machine-man interactions would become possible. The test is to look whether meteors induce sounds heard without time lag due to finite propagation velocity of sound and whether also electronic instruments detect these sounds.

Amazingly, there is evidence just for this kind of strange effects. For centuries it is known that meteors can generate audible “pop” like sound. Sound is heard instantaneously so that either we hear it as ESP through magnetic sensory canvas or ELF em waves are transformed to sounds at Earth and heard after that. Quite recently also electronic instruments have detected these sound [F3]. Amazingly, the frequencies were 37-44 Hz range contrary to the expectation that they would be in the range 20-20.000 Hz and have much weaker intensity. The generation of

sounds with the observed intensity is theoretically possible only if the electric perturbations from ionosphere have propagated to Earth as essentially unattenuated (along magnetic mirrors) or being even selectively amplified (magnetic mirrors as wave cavities).

Thus there is some support, not only for the sensory canvas hypothesis, but also for the machine-mind interactions at thalamocortical resonance frequencies. One could also look whether there are correlations between human EEG and electromagnetic perturbations of electromagnetic instruments in thalamocortical frequency range (and perhaps also at the higher harmonics of it). This interaction might be of fundamental technological important since it might make possible to control electronic instruments directly by thought.

### 2.5.3 Who Are The Senders?

In TGD Universe everything is conscious and consciousness can be only lost. Therefore it is possible to imagine several kinds of senders.

#### Deceased and/or living humans?

In some messages the senders tell that they are deceased. There are two possibilities: either the senders live in the geometric now in some other than the usual physical form or they live in the geometric past where their physical body still exists. Both options seem to be possible.

1. The conservation of magnetic flux suggests that the magnetic flux tube structure associated with the electromagnetic body survives the physical death so that both the 4-dimensional physical body of the deceased in the geometric past and also electromagnetic body in geometric present would exist. If the p-adic MES associated with the electromagnetic body continue to transform from p-adic to real form, electromagnetic bridges between the 4-D body of the deceased and physically living creatures or electronic instruments could make possible ITC.
2. Also the entanglement with and signals from the geometric past from the physical bodies of the deceased must be considered (say the communications by Kostantin Raudive). TGD based model of long term memories (all memories, even water memory) is based on the mirror idea: when I remember I look at me at a magnetic mirror located at a huge distance of light years. Therefore I see the me of the geometric past in the mirror [K78]. Magnetic mirrors can however connect me to some other person and this means communications with the persons having 4-D body in the geometric past, receiving their memories. This communication is more probable between persons have had (and still have) a close relationship generating the required magnetic mirror bonds.
3. Also the brains and bodies of living could act as sending antennae and generate unconsciously ITC messages. Thus one cannot expect that all messages would have a deep spiritual tone.

#### Magnetospheric selves?

The model for the sensory representations realized at magnetic bodies of astrophysical size inspires the hypothesis that also the magnetosphere of Earth acts as sensory magnetic canvas and is a living, conscious system. Magnetosphere could be a seat for multi-brained conscious entities receiving information from human and other brains and bodies serving as neurons of these life-forms. Various EEG frequencies correlate for various parts of the magnetosphere by resonance conditions. Especially interesting seats for em life-forms are various boundary layers of the magnetosphere, such as the plasma sheet at the night side magnetosphere and magnetopause serving also as a kind of magneto-immune system.

Remote mental interactions such as remote viewing involve aspects which suggests that they proceed via the mediation of multi-brained selves providing information necessary for the localization of the target not possessed by the remote viewer herself. Also ITC might involve these collective levels of consciousness. Empirical support for the notion of multi-brained collective levels of consciousness comes from the experiments of Mark Germaine [J66].

An operator and a subject person were involved. The stimulation of the subject person consisted of a sequence of identical sounds containing now and then an odd-ball stimulus (now

silence). The odd-ball stimulus generated an event related potential (ERP) visible in EEG and reflecting the conscious reaction. The operator was in a second room and by simple toss of coin decided whether to observe the stimuli in the computer monitor or not. The stimuli appeared in the computer monitor one second before they were heard by the subject person. What was found that when the operator saw the odd ball stimulus from the computer monitor, the ERP was weaker on the average. An 11 Hz periodicity was the major component in the difference profiles. The simplest explanation is that the brains of both the operator and of the subject person belong to a larger multi-brained self and that the evoked response represented partially the reaction of this self. When this multi-brained self had already seen the stimulus through the operator's eyes, it was not so surprised to hear this stimulus again through the ears of the subject person, and ERP was weaker. The appearance of the 11 Hz periodicity suggests that this frequency is an important correlate for the entanglement of the subject person's mental images with those of the multi-brained magnetospheric self.

### ETs and/or ITs?

The interior of Earth contains almost empty and cold space-time sheets and the magnetic flux tube structure in the core of Earth serves as a kind of thalamus like relay station. The cavity resonance frequencies associated with core and inner core are in the range 14-15 Hz and 40-50 Hz and correspond to two important frequencies of EEG. Thus also the interior of Earth might be important for consciousness.

The general TGD based view about life implies that various boundary layers containing strong energy currents driving self-organization are optimal for the emergence of life. The mantle-core and core-inner core boundary layers containing possibly liquid-crystal phases of quartz (glass) and iron, are especially interesting seats for life-forms controlling the hot liquid-crystal phase from larger space-time sheets which are very cold and super-conducting. A support for these speculations comes from the strange findings associated with crop circles. In particular, Chilbolton and Crabwood crop formations [H1, H3] can be interpreted as messages providing information about these life forms: even the genetic codes of these life-forms can be deduced and a general model for our genetic code emerges as a by-product [K26, K27]. One cannot exclude a quantum symbiosis between us and these life-forms based on a telepathic sharing of mental images, and this kind of symbiosis conforms with shamanistic and religious mythologies and the Freudian super-ego-ego-id trinity. Therefore one must consider the possibility that the senders of ITCs are ITs (intraterrestrials). Of course, quantum entanglement mechanism allows also ETs as the senders of the messages.

### 2.5.4 Knowhow Problem

How it is possible to code the information sent by the discarnate entity to say computer picture. It is difficult to imagine that the sender would be able to same as a group of IT specialists and computer engineers. There are two ways to overcome this problem.

#### Higher level multibrained selves acting as relay stations

Higher level multi-brained magnetospheric selves could act as relay stations entangling the sender of the message with the experimenter in turn entangled with the electronic instrument. The knowhow about how to encode the primary signal to various forms such as AM or FM modulated radio wave or even signal represented as a binary code could be possessed by some brains of this higher level self.

The role of these selves would be same as in the proposed realization of memes and morphic resonances of Sheldrake in terms of magnetic bodies responsible for collective consciousness [K80]. The possibility of collective gene expression based on hyper genes would make this kind of mechanism possible in the case of biological matter and would provide completely standardized communication and control tools for magnetic bodies.

### Feedback and history editing

The proposed model is consistent with the fact that EVP and ITC skills develop only gradually and require patience and that some persons are more gifted than others. The generation of the magnetic mirror bridges between senders and experimenter and experimenter and electronic instrument require time. Also the sender must learn by feedback how to code desired messages to the electronic instrument. The simplest form of feedback is a sharing of the mental images generated by say the listening of the magnetic tape in the experimenter's brain.

History editing provides quite a science fictive sounding manner to make corrections to the message. Each quantum history changes the geometric past so that history editing becomes possible in principle. There is an experiment in which a chicken confined to move in small area became imprinted to a robot [J77]. The motion of the robot was coded to a random number sequence half year before. After the imprinting the motion the robot tended to stay near the chicken which suggests that the bleak chicken was able to alter the random number sequence and thus edit history in a time scale of half year. Our long term memories are unstable and can be altered by suggestions. In TGD framework also this can be regarded as history editing applied to the sensory representations of the brain of the geometric past.

During the listening period the sender of the message could receive the information about the conscious experience of the experimenter by the sharing of the mental images induced by the message. The sender could make a quantum jump to a new history which would imply a modification the message to the electronic instrument located in the geometric past (the geometric past changes in each quantum jump in TGD framework), the experimenter would perceive the improved message, and so on. This iterative loop would lead finally to a message which generates the experience of recognition of message in the receiver. During repeated sessions sender would learn the code and would be able to send messages more easily.

### 2.5.5 Experimenter As A Medium And Amplifier Of The Signal

Experimenter could act as receiver of the ITC signal, amplify it, and send it further to the receiving instrument. Experimenter might also make possible feedback from the instrument to the sender. Both various experimental findings and TGD based view about bio-systems lend support for this hypothesis.

#### Magnetic mirror as electromagnetic bridge

The experimenter in ITC seems to play a role similar to that of the medium in spiritistic sittings. The idea about experimenter as a relay station between electronic instrument, making possible both the sending of the classical message to the instrument, and receiving the conscious response of the receiver during the reading/listening session, might indeed help to understand ITC at general level.

Magnetic mirrors are by definition magnetic flux tubes accompanied by MEs parallel to them. The Alfven waves, which represent oscillations of magnetic flux tube analogous to those of violin string, resonate with the classical em wave propagating along ME and amplify the signal. To be precise, one should speak about a mirror pair: the mirrors are the points of magnetic flux tube where ME is attached to the flux tube. The existence of magnetic mirror bridges between experimenter and electronic instrument would not be surprising. MEs and magnetic flux tubes represent topological field quanta of electromagnetic field and it would be more surprising if they would not interact with electronic instruments since these instruments interact already in Maxwell theory with external electromagnetic fields. What is new is that MEs make possible channelled transfer of energy and information: in Maxwell's theory signals would be transmitted to all directions as "mass communications" and distance would be the limiting factor unlike in case of MEs. The presence of kind of interaction would suggest that humans and electronic instruments are already now in an intense interaction and that the electronic revolution is more like a symbiotic process in which both machines and men are active participants.

The generation of electronic (and also acoustic) signal requires energy. Magnetic mirror quantum entangles the discarnate, experimenter, and the electronic instrument. Only bound state entanglement is preserved in quantum jump and thus binding energy is liberated when bound state entanglement is generated. This energy is usable energy and could provide the energy needed to



generate the signal. If stochastic resonance is involved, the noise acts as an amplifier of the signal. In the case of an acoustic signal the body of the experimenter could generate the sound and energy could come from metabolism.

### Body and brain as antennae

TGD based view about living systems indeed predicts that brain and body act as receiving and sending quantum antennae in a very wide range of frequencies. For instance, EEG can be regarded as radiation emitted by brain acting as an antenna. TGD predicts that EEG MEs are accompanied by high frequency MEs, most probably at microwave frequencies and induces self-organization at magnetic body and thus give rise to sensory representations. For instance, microwave hearing [I18] lends support for the hypothesis that brain is a receiving microwave antenna. The microwave frequency spectrum relevant for microwave audition is in the range  $.2 - 3$  GHz. A receiving antenna can also act as sending antenna and it is known that at the sunset a microwave static of unknown but presumably biological origin emerges and correlates strongly with the so called taos hum [I24]. Taos hum is a humming sound heard during night time, which can become intolerable and has no identified origin. The most plausible explanation of taos hum is as a special case of the microwave hearing.

### Are alpha waves in special role?

The general communication mechanism between the sender and experimenter could be based on fast amplitude modulation of alpha waves involving higher harmonics of  $\sim 10$  Hz wave (this is like adding small ripples in long wavelength water wave). This mechanism could in fact be equivalent with the propagation of higher frequency MEs inside  $10$  Hz ME serving as the quantum entangler.

1. Schumann resonance frequencies correspond to cavity resonances in size scale of Earth and thus might mediate telepathic communications between different selves. The lowest Schumann frequency of about  $7.8$  Hz is especially interesting in this respect.
2. It seems that the  $10$  Hz fundamental frequency assignable to electron's CD provides a first principle explanation for this frequency appearing also as fundamental biorhythm. This also explains harmonics of  $10$  Hz frequency naturally. The hierarchy of Planck constants allows also sub-harmonics and even rational multiples of  $10$  Hz frequency and one can ask whether  $5$  Hz theta frequency corresponds to dark electrons.
3. Originally the  $10$  Hz frequency emerged from the memetic code but zero energy ontology provides a first principle justification for it. One realization of memetic code would be in terms of  $7$  quark-like CDs of duration  $1/1.28$  ms with bits represented as states of quark and  $7$ : th bit representing a check bit. Genetic code could be realized in terms of  $6$  scaled down variants of electronic CD but it is not clear whether this requires that quarks appear with masses coming as half octaves of the basic p-adic mass scale corresponding to  $5$  MeV mass scale. Memetic code could act as universal code making possible communications also with "dead" matter. One can even consider the possibility that electron possesses primitive intelligence. The success of p-adic mass calculations could be indeed understood if elementary particles reside in the intersection of real and p-adic worlds and are therefore quite generally able to entangle negentropically.

Our speech uses the same mechanism ( $10$  Hz frequency is the basic vibration frequency of speech organs, which is not the fundamental frequency which is above  $20$  Hz) and so called features [E2] identified in EEG patterns can be also regarded as a fast amplitude modulation of the alpha wave (low amplitude higher harmonics of the alpha wave appear as ripples of the alpha wave). This suggests that speech is an expression of genetic or perhaps even memetic code (the number of codewords seems to be however enormous and genetic code seems to be quite enough).

The structure of the mesoscopic features of EEG [E2] suggests that the harmonics up to the  $8$ : th harmonic of alpha wave are present in EEG. This amplitude could modulate a carrier wave which should have frequency above  $80$  Hz: the presence of the carrier wave is however not absolutely necessary (the fundamental frequency defining the pitch of the voice and produced by speech organs indeed tends to be absent in EVP [J72]). Interestingly enough, the frequency

interval for so called taos hum is in in the interval 40-80 Hz [K77]. The duration of nerve pulse is consistent with the assumption that entire memetic code is realized at the level of nerve pulse patterns.

These features could communicate information to higher level multibrained selves. It has been found, that healer's alpha wave activity intensifies during healing process and magnetic emissions in ELF range have been observed. Also correlations and synchronization between alpha wave activities of Qigong masters and healees has been reported [J65]. If the brain of the experimenter serves as a relay station, the deceased (identifiable as the electrommagnetic body remaining after the physical death or as the physical body in the geometric past) could use the same code as it has used while controlling its own material body from magnetic sensory canvas during life time to both send and receive mental images. If magnetic sensory canvas is able to produce visual hallucinations and dreams it might be also able to produce visual images by sending similar commands to the brain of the experimenter serving as a relay station and preserving the topological structure of images.

### Could the body and brain act as lasers?

According to the experimental findings of Peter Gariaev and his group, the irradiation of DNA by visible laser light induces radio wave emission at frequencies ranging from ELF frequencies to MHz range [I17]. The TGD based model of the phenomenon relies on the hypothesis brain and body could act as a laser in a wide range of frequencies extending from EEG frequencies up to UV. The idea is simple: when an ion drops from a smaller to a larger space-time sheet it liberates the difference for the energies of the initial and final state. For free ions this energy is in the simplest situation essentially the difference of zero point kinetic energies. For magnetic flux tubes it is the difference of magnetic energies, which is very small and can correspond to even ELF frequencies. This leads to a many-sheeted laser mechanism: if the system is irradiated with a radiation, whose frequency is same as for the radiation liberated in the dropping, stimulated emission occurs and incoming coherent radiation can be amplified. The difference with respect to the ordinary laser is that the ions does not drop from a higher to a lower energy state of an atom but from a smaller to a larger space-time sheet. The many-sheeted laser could make possible for a body and/or brains to amplify the incoming ITC signal represented by high frequency MEs propagating along low frequency MEs generating the entanglement.

### 2.5.6 Could Stochastic Resonance Be Involved With ITC?

EVP research support the view that certain background noise is necessary for receiving messages. Skeptic would of course argue that the noise provides the source from which brain as a builder of familiar patterns constructs the signal. On basis of this observation it has been however proposed that stochastic resonance (the article [D7] is an excellent review about the principles and applications of the stochastic resonance) is the mechanism of EVP. Stochastic resonance requires a bistable system (for instance, double potential well) or an excitable system having metastable states. An essentially nonlinear phenomenon is in question.

#### Stochastic resonance

Stochastic resonance works if the message to be amplified is represented as an amplitude modulation of a carrier wave with a basic frequency  $f$  and serves as a harmonic perturbation of a bistable system which is also subject to white noise. In the resonance,  $f$  must be one half of the average frequency  $f(spont)$  for the jumps between two states of the bistable system:  $f = f(spont)/2$ . This condition has a simple physical interpretation: the height of the potential barrier separating the two potential wells varies periodically with a period which is half of the period defined by  $f$ , and the best opportunity to get to another potential well is to hop when the potential barrier is lowest possible. For the mechanical analog system the rate  $f(spont) = r_0 A$  is proportional to an "Arrhenius factor"  $A = exp(-\Delta V/D)$ , where  $\Delta V$  is the height of the potential barrier and  $D$  characterizes the intensity of the white noise.  $f(spont)$  is also proportional to a factor  $r_0 = \omega \omega_b / \gamma$  where  $\omega$  is the frequency of small oscillations at either bottom of the symmetric potential well,

$\omega_b$  is the analogous quantity at the top of barrier, and  $\gamma$  characterizes the linear dissipative force (overcritical damping is assumed).

Thus, when the white noise has a correct intensity, a weak harmonic perturbation with a given frequency is amplified in the sense that the Fourier expansion of the system's time development regarded as jumps between the two states contains a peak at the multiples of the frequency of the amplitude modulated harmonic perturbation. Neuroscientists refer to this phenomenon as a phase locking. The peaks for the higher multiples of the input frequency  $f$  are exponentially suppressed. The notion of stochastic resonance makes sense also in the quantum context: now quantum tunnelling replaces the jumps induced by the stochastic noise.

### Stochastic resonance and brain

There is a considerable empirical support for the hypothesis that stochastic resonance is responsible for both the so called temporal coding of the sensory inputs to neurons (see the references in [D7, D8] ) and for the ability of the brain to extract very weak signals from a noisy background. For instance, crickets seem to detect the signals caused by their predators from a strong background noise using this mechanism. More generally, stochastic resonance is a very attractive candidate for a quantum level neuronal mechanism for amplifying very weak EEG waves to a firing pattern in turn amplifying the original EEG waves amplified again by the stochastic resonance... citeeegII. Amplification of em fields associated with ELF MEs is analogous to physical growth would be basically in question and p-adic MEs (memes) could use any means to achieve this. The development of individual indeed involves the gradual emergence of higher frequency ELF waves above the delta band background.

### Stochastic resonance and people seeing elves and auras

It is interesting to apply the stochastic resonance model also to other experiences usually believed to be hallucinatory and purely brain generated. Some of us claim to have the ability to see elves and auras, and an interesting question is whether one could artificially induce this kind of ability by tuning the noise level of the visual perceptive field suitably. My own strange and often frightening OBE type experiences induced by the noise of refrigerator or central heating batteries could be partially understood in terms of stochastic resonance. From the visual hallucinations during my great experience I remember the strange conviction that this what I see is always present in the visual field and that I have in some strange manner only become conscious about its presence, much in the same manner as one suddenly becomes conscious of a well-defined pattern in the autostereogram containing only what looks random points.

A stochastic resonance created by the brain itself and making possible the perception of an already existing weak visual input would conform with this interpretation. The same general explanation might apply as such to the case of EMDR experiences: the EMDR method could optimize the level of the background visual noise making possible to amplify weak signals always present in the visual and other perceptive fields. Finally, the claimed encounters with the deceased induced by the presence of a medium could also be explained by the ability of medium to induce a situation in which an actual weak visual signal is amplified to a conscious perception.

It is easy to guess the reaction of a skeptic to these unconventional interpretations, and it might well be that pattern completion indeed generates information which it is not actually present originally. It is however good to remember that until quite recently the dominating theory about dreams was that cortex does its best to cook up something from a random input coming from the brain stem. For a non-skeptic person with some spiritual traits and taking his/her dreams as an essential part of the personal subjective existence this kind of interpretation seems highly absurd and even humiliating. The revision of this view has been forced by the accumulating knowledge supporting the view that dreaming is a cognitive ability learned before the age of eight, and also by the observation that dreaming as a virtual world life has an obvious survival value. Continuing in spirit of this section, one might even see the role of brain stem as a producer of the background noise making possible the amplification of the weak signals from the higher levels of the self hierarchy to dreams (at least in some cases).

### **1/f noise amplifying itself via white noise?**

What are the physical correlates of the MEs representing memes and being perhaps amplified by both brain and by the electronic instruments in ITC? Besides white noise there is also 1/f noise encountered practically everywhere [D1]. The origin of the 1/f noise is poorly understood. In TGD framework 1/f noise could be seen as a signature of real mind-like space-time sheets (giving rise to sensory qualia). 1/f noise is a good candidate for the physical correlate for the real counterparts of memes realized as MEs with the information represented by an amplitude modulated carrier wave. Also EEG could be seen as resulting from the amplification of 1/f noise (delta band for EEG resembles the spectrum of the so called spherics [F1]). The real counterparts of these opportunistic memes would correspond to amplitude modulated ELF waves using all possible means of self expression and using also stochastic resonance mechanism to amplify remote mental interactions (this brings in mind the mysterious sea in the scifi novel “Solaris” of Stanislaw Lem!).

### **Stochastic resonance and ITC**

An important question is how the message is amplified and filtered from the background noise possibly present. A possible answer to this question is stochastic resonance. Stochastic resonance could occur in the receiving instrument and/or in the brain of the receiver. ITC, in particular EVP research indeed supports the view that certain background noise is necessary for receiving messages. On basis of this observation it has been proposed that stochastic resonance (the article [D7] is an excellent review about the principles and applications of the stochastic resonance) is the mechanism of EVP.

Stochastic resonance requires a bistable system (for instance, double potential well) or an excitable system having metastable states. An essentially non-linear phenomenon is in question. Signal is in a role of the harmonic external force: the output of the bistable system is interpreted as a transformed signal. If one takes seriously the claim about the positive effects of the white noise on tape recordings, bistable system must reside either in the electronic system transforming sound signal to an electric signal or in the brain of the experimenter serving as a relay station between the sender and electronic instrument in the proposed model.

TGD Universe is quantum spin glass which means that any system should be characterized by fractal spin glass energy landscape containing valleys (energy minima) inside valleys inside... This of course means that there is plenty of bistable systems. TGD also predicts new kinds of dynamical degrees of freedom not predicted by standard physics, so called zero modes, which typically characterize the shape and size of 3-surface and also so called Kähler field (essentially Maxwell type field) of space-time surface. These new degrees of freedom could provide the required new degrees of freedom possibly making also the relevant parts of electronic instruments bistable systems.

#### *1. Does the brain of the receiver contain the bistable systems?*

Skeptic would argue that the noise used to promote the receipt of the messages is what cheats the brain of the poor pseudoscientist to recognize a feature which is not actually present in the incoming signal. The skeptic might be quite right although after listening the some of recordings I have a tendency to believe that there are actual messages there. One could however turn around the argument of skeptic. Perhaps it is indeed the brain of the experimenter where the bistable system resides and amplifies the very weak signal from the sender and sends it to the electronic instrument in electronic form. Stochastic resonance in experimenter’s brain would be involved also with the receipt of the feedback signals from the instrument by the sender of the message. This model has several satisfactory features.

1. The model is consistent with the latest facts about brain science [D7, D8]. The model is also universal in the sense that it does not require incarnate entities to be ingenious electric engineers: they can learn by trial and error how to generate desired messages by affecting the electronic instrument.
2. The model would explain why some experimenters are better than the others in receiving messages. They are like crickets able to distinguish very weak input from the high noise. If

feedback from experimenter's brain to the sender is involved this in turn helps the sender to learn to generate desired messages. The model is also consistent with the fact that the highly tuned system which works perfectly for a particular experimenter, does not work for the other experimenters. Note that the magnetic mirror bridges between experimenter and electronic instrument are essential part of the system.

The hypothesis could be tested by purposefully building EVP and ITC instruments for which the background noise can be varied.

### *2. Do electronic systems contain bistable systems?*

The hypothesis that the electronic system contains the bistable system is subject to so strong additional constraints that it does not look too plausible in standard physics framework. If the leakage of ionic currents from the magnetic flux tubes to the wires of the electronic induced by MEs gives rise to the electronic signal, stochastic resonance is perhaps not needed since the background noise is very weak. It must be however emphasized that many-many-sheeted space-time plus spin glass degeneracy might provide new physics mechanisms of transforming the ITC signal to electronic signal.

The very fact that the electronic information transfer systems should not induce large distortions of the signal, requires that the system is effectively linear. Bistable systems are highly non-linear systems unless the signal fed into the system represents sufficiently strong external force in which case system is analogous to a one-dimensional particle in an external harmonic force: archetypal model is the potential well  $V(x) = -x^2 + x^4$ . In case of magnetic tape the direction of magnetization would naturally represent the two potential wells and hopping of the particle between wells would correspond to the changing direction of magnetization. Thus, if bistable systems are involved, ordinary signals must represent strong external forces for which the system is effectively linear and non-linearity can be important only for very weak signals. In case of EVP this requires that possible messages should be contained by the portions of the magnetic tape, where ordinary signal is reduced to mere noise and the noise is sufficiently weak. Already this requirement might kill the hypothesis.

To test this option, one should find whether the electronic system transforming the sound to electric current contains portions modellable as bistable systems fed by an external signal for sufficiently weak input signals. If this is the case, then model could be tested by varying the intensity of the external noise to see whether this has any effect on the probability of receiving the messages.

## **2.5.7 How The Signal Is Transformed To A Signal In ElectronicInstrument**

One should also understand how the transformation of the ITC signal to the signal appearing in electronic instrument such as tape recorder, telephone, or radio receiver occurs.

### **Direct radio signal**

The simplest situation is direct radio signal. It is known that the voices tend to appear in the silent portions of radio signal containing only noise. This is of course natural since in this manner the masking of the signal can be avoided and might allow also stochastic resonance. If the sender or magnetospheric multi-brained conscious entity has managed to code the signal to AM or FM radio wave, and if the brain or body of the experimenter has managed to amplify it and redirect it to the instrument, then the transformation to an audible signal is not a problem.

### **“Paranormal” signal to a magnetic tape**

The first possibility is that primary messages appear as ME having a Fourier decomposition resembling sufficiently that of the sound wave, and giving rise to the required vibrations of atoms. MEs are the basic candidates for the carriers of these waves and the Fourier spectrum of the voice with respect to frequency could be coded into the Fourier spectrum of em or  $Z^0$  fields associated with ME. Hence ELF frequency range would be in question. Phase information is crucial: anyone can easily verify that a reversed speech usually consists of a gibberish despite the fact that the

Fourier spectra are same for speech and reverse speech. This suggests an amplitude modulation of the carrier wave or fast amplitude modulation producing ripples to the carrier wave as a candidate for the representation of the information contained by ME.

The sound frequency range involved with the sounds heard by humans is in the interval 20–20.000 Hz meaning the lengths of ME would vary between Earth radius and 10 kilometers. This spectrum is also claimed to be important for water memory and the mechanism of homeopathy [I14].

A concrete model for the process might look like following.

1. The signal is first transformed to an electric current, which subsequently induces a shortlasting magnetization of a soft electromagnet which in turn induces a permanent local magnetization of hard ferromagnet (magnetic tape). The strength and sign of the local magnetization depends on the strength of the current which in turn codes the strength of the sound signal. A similar transformation to an electric current occurs also for the signal in case of visual ITC.
2. A concrete manner to generate the electric current inducing the magnetization would be by inducing a leakage of a supra current from magnetic flux tubes to the atomic space-time sheets of the current wire responsible for the magnetization of the soft electro-magnet. This leakage could be induced by microwaves by a mechanism discussed in [K40]. The modulation of the microwave by sound wave would imply the modulation of the current automatically. An analogous mechanism could be at work for the radio receiver.

### Transformation of em signal to sound signal before entering the tape recorder

Classical EVP suggests that the basic signal enters to the magnetic tape as an electric signal. On the other hand, the experimental results reported by Alec MacRae [J1] are consistent with the assumption that real sounds generate the signal and that electromagnetic signal does not generate a signal in the microphone. The latter conclusion comes from the observation that Faraday cage around microphone does not affect the communication. In TGD framework this conclusion cannot be made since Faraday cage is not expected to affect MEs. The acoustic insulation of another microphone however weakens the voice so that it seems that a genuine acoustic signalling is in question. This does not of course imply that the generation of real sounds is the only mechanism: in the presence of feedback the best communication mode available could be used.

TGD based model for the real sounds generated by meteors heard both directly and recorded by microphones is based on electromagnetic signals coming along magnetic mirrors associated with the sensory magnetic canvas and acting as wave guides and transformed to ordinary sounds via the coupling with objects at the surface of Earth. Whatever the details of em signal-sound transformation are, it certainly exists, and could be involved also now: the electromagnetic signal could come either from the magnetic sensory canvas of the experimenter, of the sender, or from the magnetosphere containing the multi-brained self serving as a relay station. Higher harmonics of the frequencies 37-43 Hz appearing in case of meteors [F3] would be however required to generate the voices or shorter magnetic mirrors should be involved.

One can imagine several mechanisms for the transformation of the primary signal to sounds.

1. The mechanism transforming electromagnetic signal to sound wave could rely on piezo-electricity and frequency resonance. Quartz crystals are excellent piezo-electrets and used in radio receivers and senders. Also body acts as a piezo-electret and the body of the experimenter could transform the signal to sound. Human body could act also as a  $Z^0$ -piezo-electric transforming the  $Z^0$  signal to an ordinary sound. The so called oto-acoustic sounds (audible sounds emanating from ears) could result in the same manner. Also material objects of the acoustic environment could serve the same purpose.
2. The phenomenon of microwave hearing suggests that brain and/or body could also transform microwave signals propagating along ELF ME to ordinary sounds.

### 2.5.8 Tests For The Model Of ITC

Most tests of the ITC reduce to tests for the general mechanism of remote mental interactions, which should be also at work in length scales below body size (bio-telepathy) and for sensory

representations realized at the magnetic body. This is good news in the sense that good models usually explain many apparently unrelated phenomena and bad news in the sense that predictions are not ITC specific.

*1. Tests for the motion of electromagnetic bridges.*

1. Since the development of the magnetic mirror bridges between experimenter and electronic instrument takes time, the replacement of the magnetic tape in EVP with identical one, might make the performance poorer.
2. One could test the importance of the magnetic flux tubes by varying the strength of the local magnetic field (note that magnetic tape has a natural coupling to the magnetic flux tube structures of Earth's magnetic field) to see whether Earth's magnetic field plays a role in the effect. One could test whether the appearance of ITC messages and perturbations of magnetic field appearing at Schumann frequencies correlate. The correlations of paranormal phenomena with sunspot activity are well-known and could be tested in case of ITC.
3. Maxwell's electrodynamics, which is not equivalent with TGD, would suggest that MEs cannot penetrate Faraday's cage so that ITC would not be possible inside Faraday cage. In many-sheeted space-time this argument is lost because MEs by definition are em bridges outside the atomic space-time sheets where the Faraday cage acts. If MEs cannot penetrate Faraday cage, the TGD based model for sensory representations would fall down since it would predict that person in ideal Faraday cage could not have sensory experiences! Be as it may, one can test this aspect by putting the experimenter and/or the instrument in Faraday cage.
4. One should also test directly whether body and brain act as laser like amplifiers of em radiation at, say, audible frequencies. The work of Gariaev [I17] shows that irradiation of DNA with visible light produces radio waves also at audible frequencies. The work of Blackman and others [J69] shows that the irradiation with ELF waves at EEG frequency range induces biological effects.

*2. Tests for the ionic leakage mechanism.* For instance, the appearance of ions not originally in the system by the leakage of the supra currents and the dissipative effects caused by the leakage would be a good signature for the effect. These tests are discussed in [K40]. In the recent case one such system would the current wire inducing the magnetization of the magnetic tape.

*3. Tests for the ideas about the communication method.*

1. In remote healing the changes of alpha waves in EEG are reported to correlate with the intentions communicated by the healer. alpha waves dominate when sensory input is absent, in particular the closing of eyes stimulates alpha waves. This is consistent with the fact that EVP requires silent and dark room. A possible test would be to record the EEG of the experimenter and look whether there is a clear change in the activity in alpha band both when the tape is on and when the tape is listened to and find whether there are recognizable changes of alpha activity. In particular, one could see whether alpha activity changes at the time when the message appears to the magnetic tape. The lowest Schumann frequency 7.8 Hz is especially interesting in this respect. On basis of the experiments of Mark Germiné, also the 11 Hz frequency is interesting [J66] .
2. The sounds detected from meteors [F3] are in the thalamocortical 37-44 Hz frequency band [K77] suggesting that magnetic sensory canvas mediates ELF perturbations to both brains and to electronic instruments at this frequency range. One could in principle test whether thalamocortical resonance band in the EEG of the experimenter contains something correlating with the received message.
3. Are persons able to receive the ITC messages also able to hear microwaves.

4. Are the sounds in EVP are received electronically or acoustically. Both mechanisms might be involved. Alec MacRae has demonstrated and in his experiments signal is received as a sound [J1]. One could also test whether the pitch of the sound correlates with the acoustic environment (big room–small room).
5. One could test the role of the stochastic resonance by varying the level of the acoustic or radio noise. Here explicit formulas for the noise optimal for a signal of given frequency are available [D7].

*4. Tests for the notion of magnetospheric selves.*

The notion of magnetospheric selves might be crucial for the solution of the knowhow problem and the experiments of Mark Germino [J66] can be seen as a pioneer work in the testing of this hypothesis.

*5. Tests for the notion of history editing.* History editing is not necessary for understanding of ITC but one could test whether it is involved. Let an outsider, presumably not able to act as a relay station, listen to the magnetic tape first and document whether he/she received any message. Suppose that he/she detects no recognizable message. Next let the experimenter listen the same tape, and report what he/she found: during this session the feedback mechanism could transform the message to a recognizable form by affecting the geometric past at the moment the magnetic tape was on. Suppose that the experimenter indeed recognizes a message. Let an outsider listen the tape again to see whether there is any recognizable message now. If the proposed mechanism is correct, the outsider who did not hear any message in the first trial, should hear now a clear message. Note that one cannot replace external person with a computer since the computer records change in quantum jumps too! Note also that even the geometric memories of the external person might change if they are comparable to mechanical records: genuine subjective memories are required. Also the repeated listening of the tape by the experimenter could improve the quality of the message and the above experimental arrangement could be iterated.



## Chapter 3

# TGD Based Model for OBEs

### 3.1 Introduction

Out-of-body experiences (OBEs) [J29, J79, J89] are often understood as experience of seeing oneself from a position outside of the body. According to Susan Blackmore [J79]. OBEs are rather common: from 5 to 35 percent of subjects reports of having had at least one OBE. According to studies persons having OBEs seem to be perfectly healthy. OBEs are poorly understood in the framework of neuro science and pose a challenge for the reductionistic world view.

In TGD framework the notion of magnetic body provides an attractive starting point in attempts to understand what OBEs and related experiences are. The basic idea is that magnetic body serves effectively as a mirror defining a third person view as a cognitive representation also in ordinary wake-up state and that during OBEs this representation becomes sensory representation. Magnetic body need not always be a personal magnetic body but could correspond to a magnetic body receiving information from several brains (collective consciousness), magnetic body of another person, or be even associated with “dead” matter.

The progress in identifying dark matter as a phase of matter with large value of Planck constant making possible macroscopic quantum coherence has led to the vision about dark matter at magnetic flux quanta as quantum controller of ordinary matter in living systems. The Bose-Einstein condensates of dark photons decaying via de-coherence to ordinary photons mediate interactions between ordinary and dark matter and the hypothesis is that dark photon “laser” beams from body and brain reflected at magnetic flux quanta give rise to third person aspect of consciousness which in OBEs and related experiences are realized as sensory representations. The identification of bio-photons as end products of the de-coherence of dark photon beams is natural.

Zero energy ontology and the notion of causal diamond (or CD defined roughly as the intersection of future and past directed light-cones) brings additional quantitative ingredients to the model. Sub-CDs define embedding space ( $M^4 \times CP_2$ ) correlates for selves and by holography the 2-D partonic 2-surfaces at the light-like future and past boundaries of CDs are the ultimate space-time correlates for mental images. The moduli space for CDs makes possible a more detailed view about sensory representations discussed in the chapter “Quantum Model for Sensory Representations” [K76].

A further new element is the vision about life as something in the intersection of real and p-adic worlds. The most important outcome is that the notion of number theoretic entanglement negentropy making sense in this situation is positive so that entanglement carries conscious information. The fusion of selves (in particular mental image) by negentropic entanglement is experienced as expansion of consciousness. It is negentropic entanglement between parts of biological body and corresponding parts of the magnetic body and biological body which makes living system living. This negentropic entanglement between magnetic body and biological body is important also for OBEs.

The model leads also to a model for dreams, hallucinations, sensory feedback from brain to sensory organs, and directed attention. Concrete models for how dark photons can give rise to experiences in various sensory modalities such as vision, hearing, olfaction, and tactile senses, are proposed.

The appendix of the book gives a summary about basic concepts of TGD with illustrations. Pdf representation of same files serving as a kind of glossary can be found at <http://tgdtheory.fi/tgdglossary.pdf> [L15].

### 3.1.1 OBEs, Autoscopy, Heautoscopy, And Other Strange Experiences

#### Phenomenological characterization

The phenomenological characterization of OBEs [J9] has been discussed in [J89]. A precise definition of OBE is to have sensation of being outside the body. Autoscopy experience involves a also a sensation of seeing a mirror double of the body or part of it or at least experiencing its presence. There is a form of AS in which some internal organs are perceived. In one form of AS only the presence of double is experienced. AS experiences are often accompanied by physical difficulties such as migraine episodes and epilepsy.

Heautoscopy refers to an experience of meeting one's alter ego, doppelganger. The main differences to AS is that in AS the double is mirror image and that alter ego is experienced to have also duplicated features of psychological self.

OBEs are classified to parasomatic and asomatic experiences according to whether the person experiences of having body or not. In aparasomatic experience a detachment from both the physical and parasomatic body is experienced. Blackmore suggest that OBE starts when sensory input from the body ceases while person remains conscious [J79]. This brings in mind the notion of subtle body of spiritual practices identified as the body experienced during lucid dreaming [J62]. The notions of guardian angle and ba-ka double of ancient Egypt, could relate to the double body too.

There is also a classification of OBEs to asensory, naturalistic and supernaturalistic ones. Asensory experience lacks sensory percepts about environment, naturalistic one involves perception of familiar surroundings, and supernaturalistic other-worldly realms like heaven or visits to other planets and contacts with aliens.

One can distinguish between natural and enforced OBEs. Natural OBEs are triggered by exhaustion, illness, traumatic events, NDEs, meditation, etc.. Enforced experiences can result from intoxication, anesthesia, hypnosis, etc..

#### OBEs induced by electric stimulation

Relatively recently OBEs and AS experiences have been produced by an electric stimulation of the angular gyrus [J37]. Angular gyrus is located in the parietal lobe, near the superior edge of the temporal lobe, and is involved in processes related to verbal communication and cognition and also with the transformation of written language to internal monologue. The experience developed to a full fledged OBE as the intensity of electric stimulation was increased. The electric stimulation induced responses in vestibular and sensory-motor systems, two of three systems which govern body balance.

According to experimenters, OBE and AS frequently involves what they call pathological sensations of position, movement and perceived completeness of one's own body. These include vestibular sensations such as floating, flying, elevation and rotation, visual body-part illusions (illusory shortening, transformation or movement of an extremity) and the experiences of seeing one's body only partially during OBE or AS. Authors believe that these experiments yield neurological evidence about the common neurological mechanism behind OBEs and AS experiences.

[J89] [J10] has criticized the interpretation of experiments.

1. Only single subject person was studied. She suffered from temporal lobe epilepsy and the epileptic region was at distance of about 2 cm from angular gyrus. Hence one can ask whether genuine OBEs were in question and whether the results generalize to healthy persons.
2. The OBE was not typical. For instance, body was seen only partially and the conscious attempt of the subject person to examine it more closely led to its disappearance. The environment was not perceived.
3. The claimed localization of the spot inducing OBEs to angular gyrus might be an illusion. Same researchers have represented results in which the OBE is induced in a different manner.

Interestingly, the experience is associated with the generation of 4 Hz theta wave, which corresponds to the dominating EEG band during sleep.

4. The reductionistic conclusion that OBEs can be reduced to neuropathology and are thus “only” hallucinations is not justified. What has been shown is that electric stimulation of angular gyrus helps to induce the OBE and this leaves a lot of room for theorizing.

### Explanations of OBEs and related experiences

The explanations for OBEs can be divided to two classes.

1. Something is assumed to leave the body.

This something could be something physical or non-physical (“astral”). In some cases people who have had OBE share reported of having perceived objects that were actually there and having experienced events and dialogue that truly happened. Charles Tart has documented the case of Miss Z [J30] who in controlled experiments was able to deliver the randomly selected five digit number which was in a position which could be seen only from the position out of her body. Telepathy would be an alternative explanation for this.

2. Nothing leaves the body.

Parapsychological explanations involve remote sensing and hallucinations. Psychological explanations regard OBEs as basically hallucinations. The observation that electrical stimulation generates both AS and OBE could be seen as a support for this interpretation. Of course, one can ask what hallucinations really are. Furthermore, the reports about seeing internal organs during AS experience [J78] are not easily explainable as hallucinations.

TGD based model does not fit into either category. The model involves the notion of magnetic body serving as the third person receiving visual stimulus from the body and reflecting it back to the brain where its is processed. In this model the conflict between hallucinatory character of AS and OBEs and a real perception of body from outside is only apparent. The basic mechanism allows to develop also a more detailed model for dreams, hallucinations, third person aspect of wake-up consciousness, and directed attention.

## 3.2 TGD Inspired Model For OBEs

It is good to develop the model for OBEs by first summarizing what OBEs are and then listing the basic TGD specific ingredients of the model and then proceed by making questions (I hope that reader does not feel them to be leading).

### 3.2.1 OBEs, Autoscopy, Heautoscopy, And Other Strange Experiences

#### Phenomenological characterization

The phenomenological characterization of OBEs [J9] has been discussed in [J89]. A precise definition of OBE is to have sensation of being outside the body. Autoscopy experience involves a also a sensation of seeing a mirror double of the body or part of it or at least experiencing its presence. There is a form of AS in which some internal organs are perceived. In one form form of AS only the presence of double is experienced. AS experiences are often accompanied by physical difficulties such as migraine episodes and epilepsy.

Heautoscopy refers to an experience of meeting one’s alter ego, doppelganger. The main differences to AS is that in AS the double is mirror image and that alter ego is experienced to have also duplicated features of psychological self.

OBEs are classified to parasomatic and asomatic experiences according to whether the person experiences of having body or not. In aparasomatic experience a detachment from both the physical and parasomatic body is experienced. Blackmore suggest that OBE starts when sensory input from the body ceases while person remains conscious [J79]. This brings in mind the notion of subtle body of spiritual practices identified as the body experienced during lucid dreaming [J62]. The notions of guardian angle and ba-ka double of ancient Egypt, could relate to the double body too.

There is also a classification of OBEs to asensory, naturalistic and supernaturalistic ones. Asensory experience lacks sensory percepts about environment, naturalistic one involves perception of familiar surroundings, and supernaturalistic other-worldly realms like heaven or visits to other planets and contacts with aliens.

One can distinguish between natural and enforced OBEs. Natural OBEs are triggered by exhaustion, illness, traumatic events, NDEs, meditation, etc.. Enforced experiences can result from intoxication, anesthesia, hypnosis, etc..

### OBEs induced by electric stimulation

Relatively recently OBEs and AS experiences have been produced by an electric stimulation of the angular gyrus [J37]. Angular gyrus is located in the parietal lobe, near the superior edge of the temporal lobe, and is involved in processes related to verbal communication and cognition and also with the transformation of written language to internal monologue. The experience developed to a full fledged OBE as the intensity of electric stimulation was increased. The electric stimulation induced responses in vestibular and sensory-motor systems, two of three systems which govern body balance.

According to experimenters, OBE and AS frequently involves what they call pathological sensations of position, movement and perceived completeness of one's own body. These include vestibular sensations such as floating, flying, elevation and rotation, visual body-part illusions (illusory shortening, transformation or movement of an extremity) and the experiences of seeing one's body only partially during OBE or AS. Authors believe that these experiments yield neurological evidence about the common neurological mechanism behind OBEs and AS experiences.

[J89] [J10] has criticized the interpretation of experiments.

1. Only single subject person was studied. She suffered from temporal lobe epilepsy and the epileptic region was at distance of about 2 cm from angular gyrus. Hence one can ask whether genuine OBEs were in question and whether the results generalize to healthy persons.
2. The OBE was not typical. For instance, body was seen only partially and the conscious attempt of the subject person to examine it more closely led to its disappearance. The environment was not perceived.
3. The claimed localization of the spot inducing OBEs to angular gyrus might be an illusion. Some researchers have represented results in which the OBE is induced in a different manner. Interestingly, the experience is associated with the generation of 4 Hz theta wave, which corresponds to the dominating EEG band during sleep.
4. The reductionistic conclusion that OBEs can be reduced to neuropathology and are thus "only" hallucinations is not justified. What has been shown is that electric stimulation of angular gyrus helps to induce the OBE and this leaves a lot of room for theorizing.

### Explanations of OBEs and related experiences

The explanations for OBEs can be divided to two classes.

1. Something is assumed to leave the body.  
This something could be something physical or non-physical ("astral" ). In some cases people who have had OBE share reported of having perceived objects that were actually there and having experienced events and dialogue that truly happened. Charles Tart has documented the case of Miss Z [J30] who in controlled experiments was able to deliver the randomly selected five digit number which was in a position which could be seen only from the position out of her body. Telepathy would be an alternative explanation for this.
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TGD based model does not fit into either category. The model involves the notion of magnetic body serving as the third person receiving visual stimulus from the body and reflecting it back to the brain where it is processed. In this model the conflict between hallucinatory character of AS and OBEs and a real perception of body from outside is only apparent. The basic mechanism allows to develop also a more detailed model for dreams, hallucinations, third person aspect of wake-up consciousness, and directed attention.

### 3.2.2 Questions

In the following the model is developed by posing questions about OBEs.

#### **Where the information processing giving meaning to what is seen is carried out?**

Seeing is much more than just receiving the photons on retina, since a lot of information processing is needed to give meaning to what is seen. This essentially involves a decomposition of visual input to recognized objects having relations to each other and to the past of perceiver. This applies also to the visual percepts during OBEs. The most natural candidate for the system processing the visual stimulus and giving it meaning is the brain of the subject person.

Sharing of mental images allows to consider an alternative interpretation based on telepathy. The sensory organs in other bodies receive the visual stimulus and other brains do the information processing. For instance, “unconscious” victim of accident could share the fused mental images of people around the place of accident. This would explain the case of Miss Z studied by Tart [J30] as telepathy.

#### **Are OBEs “only” hallucinations?**

In TGD framework the first possibility is that the sensory stimulus is always artificial and comes from brain to eyes and other sensory organs by back projection. OBE would be a dream like cognitive representation, simulation rather than a real percept. REM is expected to always accompany OBEs in this case.

There is an objection against this idea. If person is unconscious or has NDE, it is questionable whether she is able to construct such high level cognitive representation as the representation of the state of her own body as seen by outsider is, and even transform it to a sensory representation. One can also ask what hallucinations really are. In TGD framework hallucinations must be generated by an artificial sensory stimulus so that hallucinations and genuine OBEs might involve the same basic mechanism.

#### **Does OBE originate from an actual sensory stimulus?**

The well-known fact that body parts indeed contain holograms about other body parts [I42] (see the discussion in [K40]) and the TGD view about the relationship between dark and living matter [K28] allows to consider seriously the possibility that OBE originates from an actual sensory stimulus.

The dark photon laser beams emanating from the body would be received by a magnetic body containing dark matter at some level in the hierarchy of magnetic bodies and would be reflected back to the receiving sensory organs along MEs possibly parallel to magnetic flux tubes rather than space-time sheets along which ordinary visual input arrives.

It is quite possible that several magnetic bodies in the hierarchy are involved. The magnetic bodies involved need not always correspond to a personal magnetic body and could receive input from several biological bodies and remote vision and telepathy might involve signals from brain reflected to a second brain via multi-brainy magnetic body. Magnetic bodies could be associated also with “dead” matter.

In this picture the case of Miss Z could be understood in two alternative ways. A dark photon beam possibly created by the visual representation of the random number (does “dead” matter generate sufficiently intense beams of this kind?) and reflected by personal magnetic body could be in question. Alternatively, the magnetic body involved could receive the information about random number from the brain of the experimenter and reflect it to the brain of the subject person.

### Why does electrical stimulation induce OBEs?

Electrical stimulation of angular gyrus induces OBEs just as the stimulation of neurons of temporal lobe induces long term sensory memories. In neurological “brain only” approach the interpretation would be that the responses in the vestibular and somatosensory system induce the AS and OBE as hallucinations. In TGD framework the response in vestibular and somatosensory system would be interpreted as a response to an actual experience of being in a detached position and orientation, and brain would process genuine sensory data about being in detached position.

One might think that the temporal ordering between the experiences and these responses would allow to decide which causes what. In TGD framework negative energy signals propagating backwards in the geometric time are however a basic element of brain functioning and this criterion need not be apply.

One imagine two mechanism generating OBEs.

1. The mechanism inducing visual OBE and related experiences could simply turn off the ordinary sensory input so that only the dark photon beams from the magnetic body and reflected back from biological body would contribute to the visual stimulus. This would occur automatically during dreams and NDE experiences.
2. The sensory input from the magnetic body could be amplified. Time mirror mechanism (see **Fig.** <http://tgdtheory.fi/appfigures/timemirror.jpg> or **Fig. ??** in the appendix of this book) could be responsible for this amplification [?]. During epilepsy strong electric fields generated by brain during epilepsy induce starvation of neurons and the electrical stimulation of angular gyrus could have the same effect. Starving neurons would generate a beam of phase conjugate (negative energy) dark photons received by magnetic body in order to get metabolic energy. The magnetic body would be in a state analogous to a population inverted (possibly many-sheeted) laser defining a hologram like representation of the body. The receipt of negative energy photons would induce a cascade like induced return to the ground state and amplify the dark photon beam arriving from magnetic body so that it would not be masked by the ordinary visual input anymore and would give rise to a percept.

### 3.2.3 Dark Matter Hierarchy, Zero Energy Ontology, Negentropic Entanglement, OBEs

Dark matter hierarchy, zero energy ontology, and the notion of negentropic entanglement lead to new insights also about OBEs.

#### Basic ingredients of the TGD inspired model

The model of OBEs involves several ingredients that are specific to TGD.

1. Magnetic bodies and field bodies are excellent candidates for the “third person” seeing the ordinary body. Magnetic body could receive a visual stimulus from ordinary body and reflect it back as a visual stimulus during OBE processed by the brain of the subject person. Thus body would see itself from the perspective of the magnetic body. Also dreams and hallucinations might involve the same mechanism. In the case of hearing sounds created by subject person could be reflected back to her ears or more plausibly, microwave hearing [I18] could be involved.
2. Topological light rays (“massless extremals”, MEs) are an element of TGD having no counterpart in Maxwell’s ED and play a key role in TGD inspired theory of consciousness. The interpretation of MEs has remained somewhat obscure. The development of TGD based model for dark matter residing at magnetic flux tubes and characterized by large value of Planck constant implying quantum coherence in even macroscopic length and time scales changed the situation in this respect. The model for dark matter as macroscopically quantum coherent phase is discussed briefly in this book in chapter [K65] and more extensively in the book “Genes, Memes, Qualia, and Semitrance” [K28]. MEs can be identified as space-time correlates of Bose-Einstein condensates (“laser beams”) of dark photons. It is however still unclear whether ordinary laser beams actually correspond to dark photon Bose-Einstein

condensates and become visible only in de-coherence to ordinary photons. Negative energy MEs can be identified as correlates for phase conjugate laser beams of dark photons. The so called time mirror mechanism is universal building block of basic biological and brain functions [?].

3. Bio-systems as conscious holograms is one of the key ideas of TGD approach [K12]. Bio-holograms [I42] suggest themselves as primary sensory stimuli quite generally. Biological body could generate dark photon “laser beams” received by magnetic bodies and reflected back to retina or perhaps to pineal gland [J31], the “third eye”. This would explain AS as well as the images of internal organs [J78]. Also other systems, at least living systems, could be seen from the perspective of the magnetic body. Remote vision hypothesis testable by using living targets not visible in ordinary sense. This would give also rise to telepathy if reflection occurs from magnetic bodies of another person.
4. In TGD framework sensory organs are identified as seats of primary sensory experience and brain only constructs symbolic representations about percept, in particular identifies objects of perceptive field. This does not exclude a considerable back projection to sensory organs modifying the sensory input. Dreaming involves back projection to sensory organs inducing artificial sensory experiences as simulation. One possibility is that dreams and hallucinations represent direct back projection to sensory organs along neural pathways. An alternative view is that the projection involves dark photon beams generated by brain and reflected back from the magnetic body. If OBEs are hallucinations, the visual sensory memories of the subject person about herself could serve as building blocks to generate simulation about what person looks like when seen from outside.
5. Sharing and fusion of mental images is one of the basic notions of TGD inspired theory of consciousness [?, K12]. One can ask whether OBE involves sharing of the visual experience of other persons involved about subject person. If this were the case, the presence of other persons would be necessary to have OBE. Sharing of mental images would explain the case of Miss Z as telepathy.

### Dark matter hierarchy

The identification of dark matter as a hierarchy of quantum phases labeled by the values of Planck constant [K33] provides additional insights about OBE experiences. Planck constant is quantized and can have arbitrarily large values and since Compton length and other analogous quantum lengths and times scale as Planck constant, this means macroscopic and macro-temporal quantum coherence and a reduced rate of dissipation.

Also the magnetic body controlling biological body (actually onion-like hierarchy of them) is assumed to carry dark matter and (forgetting ontological delicacies) dark matter could be seen as the agent responsible for the quantum control of ordinary matter in living systems. The value of Planck constant becomes also a measure for the evolutionary level of the living system and great leaps in evolution can be identified as transitions increasing the maximum value of  $\hbar$  in “personal” hierarchy of magnetic bodies [K29].

### Zero energy ontology and causal diamonds

Zero energy ontology is second new element of quantum TGD and states that all physical states have vanishing net values of conserved quantum numbers. Zero energy ontology provides a firm justification for the notion of negative energy signals consisting of (say) phase conjugate photons propagating to the geometric past. These negative energy signals are crucial element of the time mirror mechanism playing a central role in the general mechanism for intentional action, remote metabolism, and long term memory.

Causal diamond (CD) defined roughly as the intersection of future and past directed light-cones serves as an embedding space correlate for zero energy state. Space-time sheets representing zero energy states are inside CD and the future *resp.* past boundaries of CD carry positive *resp.* negative energy parts of zero energy states.

What is important from the point of view of consciousness theory is that CDs serve as embedding space correlates of selves and sub-CDs as those for sub-selves (mental images). Sub-CDs are very much analogous to music instruments in the sense that the frequencies which come as harmonics of the fundamental frequency defined by the proper time distance between tips of CD (coming as powers of two) resonate with the geometry of CD and put it to “ring”. Sub-CDs could be seen as an analog of radio receiver as far as sensory representations are considered and sending antenna as far as the motor control of biological body is involved. This allows to communicate sensory data from brain to sub-CDs at magnetic body CD in a highly selective manner. MEs (massless extremals) mediating the communications between magnetic body and biological body are also very much like strings of a music instrument. This picture generalizes the earlier music metaphor applied to axonal pathways.

A more precise definition of CD is as the Cartesian product of the intersection of future and past directed light-cone with  $CP_2$ . The hierarchy of Planck constants brings in additional structure. There is identification of preferred  $M^2 \subset M^4$  defining a preferred time direction (rest system/quantization axis for energy) and spin quantization axis. The preferred geodesically trivial sphere  $S^2 \subset CP_2$  and the selection of point assigned with  $CP_2$  at the future and past boundaries of CD gives rise to a selection of quantization axes of color isospin and hyper charge.

Sensory representations are a key element of the consciousness theory and the moduli space of CDs characterizing what kind of CDs are possible brings in new representational resources.

1. The moduli space of sub-CDs involves the position for the either tip of the sub-CD and the naïve expectation is that this position could code for the position of the perceptive field. If so the representation would be very concrete and since the size of CD is already for electron with .1 lightseconds the representations is realized automatically in astrophysical scale.
2. The moduli space of sub-CDs assignable to the mental images with another tip fixed could represent geometric qualia. Without any further restrictions this space corresponds to proper time constant hyperboloid of future light cone. The values of time parameter come in powers of two. One can however quite well consider the possibility that only a discrete lattice of the hyperboloid is realized- at least in the intersection of real and p-adic worlds.
3. A Lorentz boost for sub-CD induces scaling of frequency and scaling of the object in the direction of the boost. Therefore boost coded to the fundamental frequency of CD could code for various shapes of a figure obtained by scaling. Boost of sub- $CD$  leaving the other tip of sub- $CD$  invariant could also code for the velocity of object. Also the velocity of the object of the perceptive field could be coded to the shape of sub-CD by performing corresponding Lorentz boosts to it [K76].
4. The moduli space of CDs contains also the choice of quantization axes of energy (preferred rest system) and spin as well as the choice of quantization axes of color isospin and hyper-charge identifiable as flag manifold  $SU(3)/U(1) \times U(1)$ . Mathematician Barbara Shipman has proposed that this flag manifold is involved with the representation of geometric data in honeybee dance [A4] and I have proposed a model for what might be involved [K37].

The moduli space of CDs is thus highly relevant for the representation of the geometric data associated with the objects of the perceptive field and the this data would be communicated using MEs with harmonics of the fundamental frequency of sub-CD so that sub-CD would act like radio receiver. This includes the position of the real object codable to the position of sub-CDs at magnetic body, the velocity of the object of the perceptive field codeable to the Lorentz boost changing the shape of sub-CD and represented as scaling of the frequency assigned with the stationary object. Also the shape of perceptive field would represent this kind of geometric data. This picture supports the interpretation of sub-CDs as spotlights of attention giving information about many-sheeted space-time inside the regions defined by the sub-CDs. It would seem that sub-CDs are dynamical objects created, destroyed, and shifted in quantum jumps. This picture is also consistent with the explanation for the arrow of psychological time based on zero energy ontology [K106].



### Negentropic entanglement

The third new element is the notion of negentropic entanglement (see **Fig.** <http://tgdtheory.fi/appfigures/cat.jpg> or **Fig. ??** in the appendix of this book) making sense when entanglement probabilities are rational or even algebraic numbers. Negentropic entanglement makes sense in the “intersection of real and p-adic worlds” consisting of partonic surfaces whose mathematical representations make sense both in real sense and p-adically. Negentropic entanglement is possible also between different number fields in accordance with the idea that cognition corresponds to p-adic number fields and cognitive representations are realized in the interactions of realities and p-adicities. Living matter is identified as matter in the intersection between real and p-adic worlds. This view together with zero energy ontology allows precise definition for the idea that intentional acts transform p-adic space-time sheets to real ones and for the reversal of this transformation [K52].

It is natural to assume that negentropic entanglement is what makes living matter living and is involved with the sharing of mental images and with the formation of sensory representations by entanglement. Negentropic entanglement can be also time-like. MEs are excellent candidates for mediating this kind of entanglement whereas magnetic flux tubes would naturally mediate space-like negentropic entanglement. The sequence of negentropic entanglements would have as its upper ends sub-CDs at highest layer of the magnetic body and sensory organs as its lower ends. Even sensory organ could have negentropic entanglement with the real object of the perceptive field and this might be crucial element in the construction of the sensory representations. For instance, the deduction of distance of the object of perceptive field might rely on interferometry using the dark variants of visible photons with wave length which is of the order of the distance to the object.

### OBEs in more general framework

A general model for the remote mental interactions follows from a model for the living matter by assuming that also other biological bodies can serve as targets for the control action of the magnetic body or communicate sensory information to the magnetic body. The notion of negentropic entanglement favors biological systems as targets but it is of course an open question whether also “dead” matter could have negentropic entanglement with its magnetic body. Ordinary intentional action would represent a particular case of remote mental interaction in this framework.

Consider now OBEs in this general framework.

1. During OBE experiences the mental images constructed by brain about biological body could be absent due to the absence of the metabolic energy feed to the appropriate parts of brain taking care of the construction of cognitive mental images about biological body and communications of them to the magnetic body. The simplest representation would be in terms of bit sequences with bit 1/0 represented in terms of population inverted state/ground state of many-sheeted laser. Negative energy signals to the geometric past would be used to read these signals by inducing partial reduction of the population in inverted states. In absence of metabolic energy feed 1: s would gradually transform to 0: s. It is however essential that time-like negentropic entanglement is involved besides classical communications. This would make it possible to share the mental images.
2. In absence of these cognitive mental images to the magnetic body, magnetic body would not anymore provide strict cognitive representations of biological body and virtual world experiences would result. Since only magnetic body would contribute to the bodily experience, the low rate of dissipation due to large value of  $\hbar$  would explain the pleasant experience about the absence of the sensory noise.
3. This general picture could also explain why OBEs seem to correlate with neural disorders such as epilepsy and disorders relating to perturbed body image. During this kind of disorders the feedback provided by the sensory and cognitive input would be lacking from the brain regions suffering the neural disorder and magnetic body would be solely responsible for the body image. The lacking strict correspondence between the conformations of magnetic body and biological body would mean that the experience is hallucination from the point of view of biological body. At the embedding space level the “conformations” of the magnetic body could be rather abstract and represented in terms of positions and other moduli of sub-CDs.

### 3.2.4 A More Detailed Model For OBEs

In the following a more detailed model for various aspects of OBEs is developed.

#### **Do bio-photons result from the de-coherence of dark photon beams?**

Bio-holography provides support for the body as a hologram (more precisely, dark photon hologram). For instance, an electric stimulation of ear during Kirlian imaging of a finger tip creates a Kirlian photo from which it is possible to abstract a hologram of ear [I42] (for a TGD based model see [K12, K40]). This suggests that body parts can in some sense “see” each other. In particular, brain can “see” body parts (note that bacteria possess a primitive IR vision based on micro-tubules): this of course need not correspond to a conscious vision at our level of self hierarchy.

The biological function of bio-photons [I20] is poorly understood, and they are an excellent candidate for ordinary photons resulting when dark photon beam de-coheres. TGD based model of bio-photons can be found in [K43] and the identification as dark photons is discussed in [K28]. The findings of Peter Gariaev about the effects of visible laser light on DNA [I17] and so called phantom DNA effect [I16] provide a further support for the biological importance of bio-photons (see the discussions in [K28, K43]).

#### **What is the mechanism of out-of-body hearing?**

Mechanism could be even more general and work also in the case of other qualia. In particular, hearing might involve similar reflection of sound waves at larger space-time sheets from the magnetic body and heard as “other-worldly” sounds.

A more plausible option is that the auditory sensation is generated by dark microwave photons reflected back from magnetic body. Microwave [K73] [I18] is indeed a well-known but poorly understood phenomenon and the generation of microwaves by plants after sunset correlates also with taos hum [I24] (see the discussion in [K45]) which does not generate any response in microphones but reflects the features of the acoustic environment.

The auditory and visual hallucinations of schizophrenic persons would represent in this framework a genuine sensory input. The notion of bicameral mind introduced by Jaynes [J57] discussed in TGD framework in [K84] would fit also nicely with this picture. The “god” controlling the behavior of bicameral by giving explicit commands would correspond to some magnetic body, not necessarily that of the subject person, but a magnetic body receiving input from several brains in the social group and representing collective consciousness.

#### **Where are the sensory receptors giving rise to the primary sensory experience?**

The simplest guess is that the visual stimulus from the magnetic body is received by eyes. The fact that REM accompanies visual dreaming supports this view in the case of dreams. The receiving sensory organ could be also pineal gland [K16, K77], “third eye”, the seat of the soul according to Descartes [J31]. Pineal gland is known to contain retinal pigments and its counterpart in more primitive animals is known to function as a genuine eye. A simple test in the case of artificial OBEs is to look whether the electric stimulation of OBEs generates also REM.

If OBE hearing is indeed microwave hearing, the identification of the primary sensory receptors is not obvious, although their existence cannot be denied.

The insect olfaction relies on infrared light as discovered by Callahan [I37] (see the discussion in [K37]). One might therefore wonder whether also humans possess olfactory receptors sensitive to IR light, and whether the emission of dark IR photons reflected from magnetic body could play some role in olfaction and in the generation of olfactory hallucinations. One can even ask, whether the molecular recognition mechanism underlying chemical senses relies on IR light. It is known that human nose contains so called vomeronasal organ [J2] sensitive to odors having sexual or social meaning but that these odors do not give rise to a conscious experience.

It is known that blind persons can learn to “see” when their skin is stimulated by electromagnetic fields representing the environment. Perhaps dark photon beams could induce also tactile sensations. Quite generally, the earlier proposal that information in all sensory modalities can be transformed to field patterns represented by MEs could sharpen to the hypothesis that the

information in various sensory modalities allows a representation as dark photon beams inducing corresponding sensory qualia in the interaction with appropriate sensory receptors.

### What is the mechanism causing the kinesthetic sensations during OBEs?

The model should also explain sensations of lifting, flying experiences, and the experiences of being in translational or rotational motion. The motion of the magnetic body with respect to the physical body should induce this kind of sensations. The basic idea is simple: generalize the mechanism allowing to hear the motion of a sound source. Generalizing from sound waves to dark photon beams, the sensation in question would be basically due to the Doppler shift of the dark photon beams travelling between biological body and the moving magnetic body. The change of the dynamical hologram resulting in the interference of a bodily reference beam and Doppler shifted reflected beam in quantum jumps could be responsible for the sensation.

This model could also resolve an objection against the hypothesis that sensory receptors experience the primary qualia. The objection is based on train illusion. When you sit on a train and look at second train which starts to move, you can have an illusion that it is your train that moves. The illusion is not a mere belief but involves a sensation of acceleration in the entire body. There are two options.

1. The sensation is a response to various bodily activities induced by the belief of being in an accelerated motion.
2. The sensation is caused by a primary sensory input induced by the acceleration. This sensory input must be produced artificially in the case of train illusion.

Consider first a genuine accelerated motion of the biological body. One could argue that in absence of visual, auditory or other sensory information about being in accelerated motion, there is no belief about being in accelerated motion so that acceleration is not perceived at all for option a). This makes option a) implausible. For option b) the acceleration of the biological body with respect to the object defining the rest system is directly perceived. The Doppler shift of the dark photon beams radiated from biological body and reflected back from the rest system would induce the sensation. Reflection could occur either from the rest system or a magnetic body associated with it.

One can imagine two mechanisms creating an illusory acceleration for option b).

1. If the fixation of the attention to the moving train means the presence of dark photon laser beams connecting biological body and train or a magnetic body associated with it, the Doppler shift of dark photon beams could induce the sensation of acceleration.
2. Directed attention could cause a personal magnetic body to mimic the motion of train so that the relevant part of it deforms in the direction of moving train to keep the distance to the moving train fixed. This would induce train illusion by the same mechanism as in case 1).

For both mechanisms the reflection of dark photon beams becomes the fundamental mechanism of directed attention. Attention would mean a formation very concrete bonds between subject and object or a representation of object at the personal magnetic body: the rays connecting the eyes of cartoon characters would represent a very profound idea about consciousness. Both views about attention mean a clear-cut deviation from the prevailing neuro-scientific thinking according to which the experienced world is virtual and completely detached from the real world.

Cliff illusion might be an appropriate name for the disgusting feeling in stomach which one feels on the brink of a precipice. Sensory imagination about falling down is in question and could be induced by the deformation of the personal magnetic body such that it mimics free fall.

The floating sensations and strange deformations of personal body during OBEs could also correspond to the deformation dynamics of the magnetic body which could be also caused by external influences. If the size of the magnetic body is measured using Earth radius as a natural unit and if the personal magnetic body co-rotates with Earth, the variation of the effect of the solar wind could induce periodic deformations of the magnetic body as in the case of Earth's magnetic field. This could reflect itself as diurnal alterations in the shape of the body experienced during

OBEs: a contraction during day time and an elongation during night time. Sunspot maxima induce magnetic storms and these could have strong effects on the shape of the body perceived during OBEs.

### **What is the mechanism making possible to see internal organs?**

Becker tells in his book “Cross currents” [J78] about a young cancer patient who told that he can see the interior of his own body. The patient could also locate the remnant of the tumor correctly. The simplest explanation is that magnetic body at some level of hierarchy reflects the dark photons emitted by the internal organs.

Usually this does not occur and one should understand why the emission occurred in the case of the cancer patient. There is evidence that bio-photons leak out from non-healthy organs [I20]: this might mean that organs send more intense dark photon beams reflected at the magnetic body.

Time mirror mechanism involving time reflection instead of ordinary reflection suggests itself as an alternative explanation. The cells suffering starvation generated phase conjugate dark photon beams in order to get metabolic energy. This in turn induced a cascade like emission of positive energy dark photon beams from the magnetic body instead of mere time reflection.

### **3.2.5 The Role Of The Magnetic Body In The Case Of Other Brain Functions**

During the construction of the model of OBEs it became clear that the reflection of dark photon beams from the magnetic body could serve as a building block of several ordinary brain functions. It has been already found that dark photon beams could define a fundamental mechanism of directed attention.

#### **Dreams and hallucinations and magnetic body**

The reflection of dark photon beams from the magnetic body could be involved also with dreams and hallucinations so that the neurological similarity of AS experiences and OBEs does not mean that both are hallucinatory. The “subtle body” assigned by many spiritual traditions with the dreaming state (for a nice summary see [J62] ) would correspond to the magnetic body. In this case mental images constructed in brain would induce dark photon beams sent to magnetic body and reflected back. The mechanism would also naturally explain autoscopic and heautosopic experiences, in particular the ability to see internal organs.

#### **The relationship of EMDR experiences to OBEs**

Near-death experiences are not the only manner to get convinced about life after death. So called eye-movement de-sensitization and reprocessing (EMDR) discovered by Francine Shapiro [J18] induces what could be interpreted as after-death communications (see the discussion in [K75] ). The experiences of subject persons are claimed to be induced by this therapy in a highly reliable manner: according to [J18] 98 per cent of patients willing to participate the therapy had after death communication experience. It does not matter what the religious convictions of the subject person are and the experiences are actually rather easy to induce. It does not matter if the loss is traumatic or not or whether it is recent or occurred for decades in past.

The experiences resemble near death experiences (light tunnels, beautiful landscapes) and involve spiritual contact with the deceased. The EMDR technique involves getting the patient to move his or her eyes in a particular rhythmic fashion while at the same time attending to a particular aspect of the traumatic memory. How EMRD works is poorly understood as yet: possibly the fact that the shifting of eyes leads to increased brain processing is of importance. Notice that rapid eye movements REM are also involved with dreams.

A possible explanation is that EMDR experiences involves visual communication using dark photon beams and/or their phase conjugates with the 4-D magnetic bodies of the deceased ones located possibly in the geometric recent or past via the magnetic mirrors associated with them. Essentially the same mechanism as involved with long term episodal memories could be in question: the only difference would be that the magnetic mirrors now mediate information not from own 4-D body from the 4-D body of the deceased.

### Third person aspect of conscious experience

Our conscious experience involves so called third person aspect giving a symbolic bird's eye of view about ourselves. Magnetic body could take the role of the third person. At the fundamental level this representation could be based on sensory stimuli originating from body and reflected back to sensory organs. It would be completely masked by the ordinary sensory input in wake-up state but distilled by brain from the dominating sensory input and coded to a cognitive representation to minimize the amount of irrelevant information. A strong interference of this kind of sensory representation with ordinary sensory input would be obviously highly undesirable. The third person aspect could be present always and be based on the reflection of dark photons along MEs parallel to magnetic flux tubes.

### Feedback to primary sensory organs via reflection from magnetic body

One objection against the hypothesis that primary sensory organs are seats of sensory qualia is that sensory stimuli are only the raw material sculptured into actual sensory perceptions and that directed attention chooses what aspects of sensory stimulus are amplified and which neglected. I have proposed that there is a feedback by projections to the primary sensory organs from brain generating artificial sensory stimuli modifying the primary sensory input. This feedback could be realized also as a reflection of artificial dark photon beams generated by brain from the magnetic body and received as such by eyes or received by brain and channelled to eyes via MEs parallel to visual pathways.

### Does imagination involve feedback via magnetic body?

One can wonder, whether also imagination could involve reflection of dark photon beams from the magnetic body. In TGD framework the hypothesis that sensory qualia are generated at primary sensory organs and brain constructs only symbolic representations about experiences circumvents the basic objections such as the experience of phantom leg. In this framework imagination and cognition can be identified as symbol generating activities which are not initiated at sensory organs but at some higher level of the hierarchy starting from sensory organs and ending at the associative areas of cortex.

Imagination could however involve also transformation of symbolic representations to dark photon beams reflected back from the magnetic body. This input would not contribute to sensory input but might be abstracted from the sensory input and might serve as a kind of feedback. In absence of ordinary sensory stimuli the input from the magnetic body would dominate and imagined mental images would transform to dreams or hallucinations.

### Sensory memories and magnetic body

In some exceptional cases often associated with a serious damage in cognitive areas of brain the feedback from the magnetic body could give rise to a genuine sensory representation making possible direct sensory memories. Examples are autistic persons with ability to remember visual scenes music pieces in every detail and also reproduce them.

One explanation is sharing of sensory mental images of geometric past. An alternative explanation is that the information about sensory memory is communicated from the geometric past in symbolic form and transformed to a dark photon beam reflected back from the magnetic body. The fact that angular gyrus is involved with the translation of written language to internal speech and the abstraction of meaning of visual metaphors supports the view that a transformation of linguistic statements to concrete images projected to the magnetic body occurs in this process.

I have proposed a mechanism [K76] explaining synesthesia. The association of different sensory modalities could also occur via a transformation of sensory input in given modality to dark photon beam reflected from magnetic body and generating a sensation in another modality. Synesthetes are also known to be capable of amazing sensory memory feats [J74] and I have proposed an explanation based on time mirror mechanism [K76]. Also in this case neurons in certain region of left brain hemisphere suffer starvation which should be lethal by standard wisdom.

As a matter fact, the starvation mechanism seems to be a very general mechanism: Callahan has found evidence that insects find more easily the plants suffering from under nutrition [I33] (see

the discussion in [K39] ). Even the fasting common in spiritual practices could be seen as a method to get body entangled with magnetic bodies by using time mirror mechanism.

### 3.2.6 Psychedelics Induced Experiences And Magnetic Body

There is a book about psychedelic induced experiences titled as “Inner paths to outer space” (<http://tinyurl.com/gnb4bp9> ) written by Rick Strassman, Slawek Wojtowicz, Luis Eduardo Luna and Ede Frecska [J45]. It took some time to realize that I have actually have met the Luna and Frecska.

The natural TGD inspired hypothesis to be discussed in sequel in detail goes as follows.

1. Psychedelics bind to the same receptors as the neurotransmitters with similar aromatic rings (weaker assumption is that neurotransmitters in question possess aromatic rings). This is presumably consistent with the standard explanation of the effect of classical psychedelics as a modification of serotonin uptake. This binding replaces the flux tube connection via neurotransmitter to some part of the personal magnetic body with a connection via psychedelic to some other system, which might be even in outer space. A communication line is created making among other things possible remote sensory experiences.

Magnetic fields extending to arbitrary large distances in Maxwell’s theory are replaced with flux tubes in TGD framework. The magnetic bodies of psychedelics would carry very weak magnetic fields and would have very large  $h_{eff}$  - maybe serving as a kind of intelligence quotient.

2. This would be like replacing the connection to the nearby computer server with a connection to a server at the other side of the globe. This would affect the usual function of transmitter and possibly induce negative side effects. Clearly, TGD inspired hypothesis gives for the psychedelics much more active role than standard hypothesis.
3. Psychedelics can be classified into two groups depending on whether they contain derivative of amino-acid trp with two aromatic rings or phe with one aromatic ring. Also DNA nucleotide resp. its conjugate have 2 resp. 1 similar aromatic rings. This suggests that the coupling between information molecule and receptor is universal and same as the coupling between the two bases in DNA double strand and consists of hydrogen bonds. This hypothesis is testable since it requires that the trp:s/phe:s of the information molecule can be brought to same positions as phe:s/trp:s in the receptor. If also protein folding relies on this coupling, one might be able to predict the folding to a high degree.
4. A highly suggestive idea is that molecules with aromatic rings are fundamental conscious entities at the level of molecular biology, and that more complex conscious entities are created from them by reconnection of flux tubes. DNA/RNA sequences and microtubules would be basic examples about this architecture of consciousness. If so, protein folding would be dictated by the formation trp-phe contacts giving rise to larger conscious entities.

This model meets of course strong objection: finite light velocity does not allow communications with outer space in standard physics framework. In TGD framework Zero Energy Ontology changes the situation. Second objection is that the communications require huge amount of energy unless they are precisely targeted. The third objection is that quantum coherence in very long, even astrophysical scales is required. In TGD framework these objections do not apply.

#### Some background about psychedelics

Psychoactive drugs can be classified into three basic types. Some raise the activity level (excitation), some calm down (inhibition), and some change the character of consciousness profoundly. Psychedelics/hallucinogens [J45] belong to the third group. Psychedelics (such as psilocin, psilocybin, DMT, LSD) containing aromatic rings and many of them (such as psilocin, psilocybin, DMT) attach to serotonin receptors.

As the official term “hallucinogens” implies, psychedelic induced experiences are regarded as hallucinations in the materialistic world view although the denial of the reality of subjective

experiences themselves requires a really hard-nosed skeptic. The title of the book reveals that the question posed in the book is whether these experiences could be about real world, kind of sensory input from distant parts of the Universe. The indigenous people using ayahuasca and similar psychedelics have regarded these experiences involving meeting of representatives of other civilizations as perceptions about real worlds. Also Terence and Dennis McKenna, who are pioneers of systematic study of the effects of various psychedelics, shared this view. In the materialistic ontology of standard physics this kind of interpretation is of course excluded. That hallucinations are in question is “obvious”, too obvious actually!

The classical psychedelics are psilocin and psilocybin contained by mushrooms, DMT found in ayahuasca, and mescaline found in peyote cactus. DMT is an endogenous psychedelic and there is pumping of DMT through blood-brain barrier so that DMT could have important brain function.

The aromatic ring structures of psychedelics and neurotransmitters (<http://tinyurl.com/d8636or>) involved provide a more concrete view about the situation.

1. Classical psychedelics are derivatives of two basic chemical groups: tryptamine and phenethylamine which in turn derive from the amino-acids tryptophan and phenethylamine.
2. Trp (<http://tinyurl.com/y967c489>) is characterized by pair of aromatic rings (6-cycle and 5-cycle). Psychedelic psilocin (<http://tinyurl.com/yanyvhgl>), <http://tinyurl.com/blkp76t>, DMT (<http://tinyurl.com/osfg9r3>) have 2 aromatic rings. Neurotransmitter serotonin (<http://tinyurl.com/14h2g2y>) has also two aromatic rings.
3. Phe (<http://tinyurl.com/kr5cvud>) has single aromatic ring (6-cycle). Psychedelic mescaline (<http://tinyurl.com/cgw7nuv>) has single aromatic ring. Neurotransmitters dopamine (<http://tinyurl.com/bvxmwch>) and norepinephrine have one aromatic ring. Note that both serotonin, dopamine, and norepinephrine (<http://tinyurl.com/yaxyj9q6>) are associated with mood disorders: clearly control in long time scales is in question, which in TGD framework suggests very large size scales for the parts of magnetic body involved.
4. Remarkably, DNA and RNA nucleotides can be classified to those with two aromatic rings (pyrimidines A and G) and their conjugates with one aromatic ring (purines C, T and U). Note that also his and tyr are amino-acids (<http://tinyurl.com/jsphvgt>) with single aromatic ring (<http://tinyurl.com/yb492da6>). Information molecules involve often aromatic rings. For instance, hormones involve often complex rings structures. Also hydrophobic second messengers (such as cAMP) (<http://tinyurl.com/yajhj9zb>) involve aromatic rings.
5. LSD (<http://tinyurl.com/c112ox7>), which is synthetic psychedelic, has 3 6-rings and one 5-ring.
6. The classification of the neurotransmitter receptors (<http://tinyurl.com/cqyoref>) provides further insights. They are classified into two groups. Ligand gated receptors can be excited and inhibited by certain neural transmitters. G-protein coupled receptors (<http://tinyurl.com/y9qesr87>) modulate the actions of excitatory (glutamate, aspartate) and inhibitory neural transmitters (GABA, glycine). Most neural transmitters bind to G-protein coupled receptors and this is true for classical psychedelics and for serotonin, dopamine, and norepinephrine.

The first guess is that the presence of aromatic rings determines the character of the transmitter receptor pair and that G-protein coupled receptors having aromatic rings are above ligand gated receptors in the hierarchy and control them. They would correspond to two different levels in the hierarchy of magnetic bodies. Note that also LSD binds to G-protein receptors.

According to the book [J45], pineal gland might be in a special role concerning psychedelics.

1. Pineal gland is the only nucleus of brain, which does not appear as left-right pair: this suggests that its functions relate to a control of the entire brain in long time scales. Descartes regarded pineal gland as the seat of soul. Pineal gland is also known as “third eye” and in lower species it indeed serves the function of eye.

2. Pineal gland is responsible for the production of melatonin: the production rate varies with a circadian rhythm. Melatonin is a serotonin derived hormone and therefore has 2 aromatic rings: this suggests that the amount of serotonin is higher in pineal gland than elsewhere in brain. Melatonin helps in sleep disorders and affects also other parts of brain. One can ask whether melatonin is involved with establishing of distant flux tube connections during sleep - not only in pineal gland but also in other parts of brain - and whether these connections are built up during sleep.
3. There is some evidence that pineal gland can produce DMT from tryptamine (<http://tinyurl.com/osfg9r3>) *believed* to be released during dreaming, during spiritual and mystical experiences, and during the time of death. Taking the title of the book seriously, one can ask whether this eye is able to see also to cosmic distances possibly using large  $h_{eff}$  photons and whether DMT is involved.

### Could instantaneous communications in cosmic scales be possible in TGD Universe?

In TGD inspired ontology the notion of magnetic body with astrophysical, galactic or even supergalactic size changes the situation completely. The basic communication tool would be touch of magnetic bodies generating reconnections and making possible signalling from the biological body to the member of distant civilization. The perception of the biological body of alien would differ in no manner from that of my neighbor since the mechanisms would be the same as involved with the transfer of sensory data to my personal magnetic body and control commands from there to biological body (at least through genome).

The basic objection against the possibility suggested by the title of the book is that finite light velocity poses absolute upper bound for the distance of objects with it is possible to be in contact during “trip”. One must be however very cautious here: the assumption that signals propagate only to singlet direction of time is essential also and derives from classical thermodynamics. In TGD framework second law continues to hold true but the arrow of geometric time for zero energy states changes in each state function reduction occurring to the either boundary of CD. Hence instantaneous communications (“remote seeing”!) using reflection in time direction become possible even over cosmological distances and define among other things the mechanism of memory in TGD Universe.

Time consuming and expensive space travel would become un-necessary: our magnetic body giving us cosmic size together with zero energy ontology making possible instantaneous “seeing” of both future and past by reflection of photons in time direction would be enough. Memory and anticipation would be basic examples about seeing in time direction. This view would also resolve Fermi paradox. We could be actually in a continual contact with the distant civilizations but without realizing it. One can ask whether similar contacts could take place in psychedelic induced experiences. Memories and future plans would be examples of “seeing” in time direction. The continual re-creation of the Universe by quantum jumps would of course mean that the actual future/past need not be same as those which are “seen”. Shamans identify various plants as conscious entities teaching them - in TGD framework this would translate to magnetic bodies of representatives of distant civilizations remotely teaching the representatives of more primitive civilizations.

What is the precise meaning of the catchy phrases “communications with geometric past/future”, “time reflection”, and “seeing in time direction”.

1. The recent view about state function reduction in Zero Energy Ontology leads to a precise identification of self as conscious entity. Self corresponds to a sequence of state function reductions leaving the passive boundary of causal diamond (CD) invariant and also Zero energy states correspond to superpositions of state pairs at opposite boundaries of CD. State function reduction leaves the member of the state pair at either boundary of CD (call it passive boundary) invariant - this is the counterpart of Zeno effect.

In the analog of unitary evolution following each reduction the position of active boundary is shifted to geometric future and the state at it is changed. This is the counterpart of unitary time evolution at active boundary. The increase of the temporal distance between the tips of CD gives rise to the experienced flow of time. Negentropy Maximization Principle



(NMP) eventually forces the first reduction to the opposite boundary of CD: self dies and re-incarnates at the opposite boundary and growth of the CD continues at opposite direction. The new self has arrow of time opposite that for the old one. The first state function reduction generates negentropic entanglement and can increase the value of  $h_{eff}$  so that evolution becomes possible.

2. In this framework geometric memories correspond naturally to time reversed sub-selves defining mental images. The space-time region (active boundary of CD) wherefrom they receive sensory information is indeed in geometric past of the self so that the interpretation as episodal memory makes sense. Also classical communications are naturally associated with sub-self and its time reversal. Note that precognition is memory from the point of time-reversed self. During sleep we precognize our geometric future.

Consider now communications with distant objects in this framework.

1. Negative energy signal would mean death of sub-self representing mental images and its re-incarnation in the geometric past accompanied by negative energy signal received by the new sub-self. The death of the time-reversed sub-self generates a sub-self with original arrow of time receiving the accompanying positive energy signal. The dying sub-self sends a signal received by its re-incarnation!
2. Communications with distant parts of the cosmos would be experiencing the time reversals of one's own mental images! We would be quite literally cosmic entities. Study of cosmos would be study of our own minds. In this situation mind is only conscious about itself. If Mind is conscious about other Mind it must fuse with it to single Mind by generating negentropic entanglement, otherwise it has no experience about other Mind. As far as conscious experience is involved, there is only one Mind. This is the TGD analog for One Mind theory and is able to avoid the paradox.

If the sub-self representing self model dies as one falls in sleep and re-incarnates as its own time reversal at the opposite boundary of CD, sleep could involve communications with distant parts of the Universe. Pineal gland generating DMT could play a key role in this process.

### Why information molecules containing aromatic rings should be so important?

I have considered the question of the title in [L22] [K74] (<http://tinyurl.com/yatfreqe>). The basis idea is that aromatic ring can carry the analog of supra-current as electron pair and this current generates a dipole magnetic field represented as flux tubes around the ring. This makes molecules with aromatic rings basic conscious entities in living matter. The flux tubes can carry dark matter and if there are several molecules with aromatic rings near each other, reconnections can take place and give rise to larger structures with building bricks connected by pairs of flux tubes carrying supra currents and dark cyclotron photon signals.

DNA would be the fundamental structure of this kind. Each base-pair would contain  $1+2+1+1=5$  (two rings from sugars) aromatic rings and longer DNA sequences would define larger conscious entities. Microtubules contain also aromatic rings assignable to 2 amino-acids phe and trp appearing in the tubulin molecules. Of course, all proteins contain these aromatic rings possibly integrating by flux tube connections to larger conscious entities. In this picture it would not be surprising if the basic information molecules would also involve aromatic rings.

DNA letters A,G and their conjugates T,C have the ring structures of trp and phe respectively and base pairs in the double DNA strand correspond to trp and phe ring structures connected by hydrogen bonds. Could the information molecule-receptor protein coupling rely on similar couplings with trp and phe playing the role of fundamental plugs. This hypothesis predicts that more complex information molecule-receptor pairs should have geometries in which trp:s and phe:s can meet each other naturally. Also protein folding could involve similar trp-phe self-couplings by hydrogen bonds determining the folding to a considerable degree. Protein folding would be determined basically by the generation of negentropic entanglement dictated by NMP and its understanding would require quantum theory of consciousness.

### Psychedelic-receptor complex as plug-in to cosmic internet and a new perspective on remote seeing?

If one - just for fun - takes seriously the claims of shamans, one must ask whether our brain has well developed tools available for building contacts with distant civilizations and what these tools might be. The receptors of neural transmitters are obviously the natural candidates for the pathways to cosmos. In the case of neural transmitters these would serve as pathways to the personal magnetic body (with onion-like structure). Neural transmitters could be however replaced with psychedelics if they have a geometric structure allowing a binding to the corresponding receptors. If psychedelics have flux tube connections to very distant parts of the Universe, a connection is generated.

1. One can argue that evolutionary pressures have forced living matter to develop highly standardized connections to various parts of the personal magnetic body and possibly also other magnetic bodies. Personal magnetic body has astrophysical size and EEG frequencies would correspond to communications in Earth size scale. Receptors serving as Josephson junctions emitting Josephson radiation with frequency characterised by  $h_{eff}$  are natural candidates for plug-ins.
2. The model for cell membrane as Josephson junction leads at the microscopic level to the view that the proteins associated with various ion pumps, channels, and receptors (of also neurotransmitters in postsynaptic junction) define Josephson junctions to which magnetic flux tubes are associated and characterized by local value of Josephson frequency, that is membrane potential and Planck constant  $h_{eff}$ . As the information molecule is attached to a receptor, a connection to some part of the some magnetic body would be generated and split as the molecule is not present. These connections are possible in the scale cell, organelle, organ, organism, population and maybe even in the scale of cosmos. Psychedelics affect serotonin receptors so that serotonin spends longer time in receptor.
3. The simplest picture is that the connection corresponds to a pair of flux tubes. As the connection is broken, the pair has suffered reconnection cutting it to two U-shaped closed flux tubes. When molecule is attached to the receptor, these U-shape closed flux tubes reconnect. The actual situation is of course expected to be more complex but the basic principle would be this.
4. Neurotransmitters and also other information molecules can be seen as molecules at the ends of flux tubes having ends in some fixed subsystem X. The attachment of neurotransmitter to the receptor would build a flux tube connection between postsynaptic neuron and X. The magnetic bodies in question characterised by passwords defined by collections of cyclotron frequencies corresponding to a hierarchy of space-time sheets. The Josephson frequency associated with the receptor is inversely proportional to  $h_{eff}$ . The natural guess is that it corresponds to the cyclotron frequency of the magnetic body part for electron, proton, or some ion associated with it. Josephson frequencies should serve as kind of passwords and receptors would be in one-one correspondence with these passwords defining gateways even to the outer space if the value of Planck constant is large enough.

The basic difference to ordinary view is that information molecules build only connections: after the establishment of a connection dark supracurrents and dark photons take care of the communication. Attaching the information molecule to receptor is like clicking a link in web.

5. Psychedelics would replace the ordinary neural transmitters building up this kind of flux tube connections in the normal situation so that the connections could be to quite different places.

One might be able to test this crazy hypothesis.

1. Pineal gland could still serve as the "third eye" but utilizing large  $h_{eff}$  photons. Fishes and birds are able to navigate to their birth places. The strongest assumption is that the flux tubes connect birth place and place of migration.

This mechanism could involve dark electron Cooper pairs at the magnetic flux tubes of Earth's magnetic field generated by visible photons with energies above energy of red light making

possible to move along magnetic flux tube. As the direction of flight ceases to be along it and spin direction of cyclotron Bose-Einstein condensate changes, cyclotron transitions would induce dark photon emission at energy of visible photons in turn generating visual sensation serving as a signal allowing to correct the direction of flight. This would explain why radiation at MHz frequency leads to disorientation (cyclotron transitions are induced resonantly).

This need not be enough. Could also “remote seeing” by pineal gland using the dark light coming along flux tubes (or maybe even active variant of this process by sending light which is reflected back in time direction). What about remote seeing in the “usual” sense of the word: could psychedelics help also in this process?

2. The role of DMT is especially interesting. Body synthesizes it and pumps it through blood-brain barrier. I learned in private discussion that the experiences induced by DMT are relatively predictable (Terence Mac Kenna has described it as a sudden “dropping” to another world somewhere “below” through some kind of wall) whereas other psychedelic substances induce rather unpredictable experiences.

Could it be that DMT corresponds to a permanent connection to some fixed external magnetic body or to a higher layer of level of personal magnetic body with permanent reconnection to some part other magnetic body? DMT as also other psychedelic substances would only help to induce the signal as Josephson radiation. This would be analog to the higher probability of remote mental interaction due to pre-bonding. What happens during sleep: is this connection generated during sleep: what about concentration of DMT during sleep in various brain regions.

3. The information molecule-receptor complex would be associated with the communications to a part of magnetic body determined by the flux tube assignable to the information molecule and possible communications from magnetic body as sensory experiences such as psychedelic experiences and mediated by radiation in opposite time direction. Also control commands from magnetic body - assumed to be realized as signals in opposite time direction as compared to sensory signals - are important and a natural assumption is that the commands initiating gene expression enter through genome via flux sheets traversing through DNA: the time scale for gene expression is slow and also other mechanisms are very probably involved. If both genome and cell membrane can (on general grounds it seems that they must do so) send signals in both time directions, the general vision about motor action as time reversal of sensory perception implies that cell membrane receives also control commands.

More generally, the complex formed by reacting biomolecules and catalyst could form a complex receiving control commands from the magnetic body. A temporary fusion of a catalyst molecule and of reacting molecules could serve as the analog of the information molecule-receptor complex. The protein Josephson junction associated with this complex would receive in a resonant manner cyclotron radiation from the magnetic body inducing a transition to a state in which the potential barrier preventing the reaction would be lower.

4. An interesting but ethically questionable test for the hypothesis would be following. Transfer neurotransmitters associated with the of subject B to the brain of person A, and see what effect they have on conscious experience of A. If the proposal is correct, person A would have flux tube connection to the magnetic body of B, and might receive some memories of B for instance. Could transplants induce similar effects? Heart transplants are reported to have strange effects suggesting that heart (having a lot of neurons) has emotional memories.

Irrespective of whether one takes seriously the thought game leading to this proposal, one must admit that it would provide deep for the notion of “information molecule”.

### Still about the mystery of DMT

In FB I got a link to a very interesting article about DMT (N,N-Dimethyltryptamine, see <http://tinyurl.com/y8qrp8tc>). DMT (see <http://tinyurl.com/osfg9r3>) is psychedelic or hallucinogen - depending on one’s attitudes. DMT is used for spiritual and healing purposes in many

cultures. The effect is short-lasting: from 5 to 15 minutes. DMT induces mystical experiences, euphoria, dynamical geometric hallucinations of geometric forms, experiences about meeting of higher intelligences, extraterrestrials, elves, and even God.

First some facts about DMT.

1. DMT is found in both plants and animals and is the only naturally occurring psychedelic. Its occurrence in the pineal gland of rodents and therefore also of mammals has been reported.
2. Chemically DMT is a structural analog of serotonin and melatonin and involves aromatic 6-cycle and 5-cycle with common edge appearing in amino-acid tryptophan (see <http://tinyurl.com/przan6k>). Also DNA nucleotides A and G have this double cycle structure but have however more than one nitrogen atom.
3. The biosynthesis of DMT from amino-acid L-tryptophan (occurring endogenously in plants but not in animals) has been detected in rabbit's lungs. Whether DMT is produced by brain is still an unsettled question. It has been even argued that DMT is mere waste.

In TGD framework aromatic cycles serve as indication that molecule contains paired valence electrons with the value of  $h_{eff}/h = n$  higher than its standard value: this explains the delocalization of electrons to longer than atomic length scale.  $n$  would serve as a kind of intelligence quotient: the larger the value of  $n$  is, the larger the maximal value of entanglement negentropy of the system is (understanding of this statement requires going outside the framework of the mathematical framework of standard physics: I call this framework adelic physics [L37] [L38] (see <http://tinyurl.com/ybp74yf8>).

In this picture the interpretation as a waste does not look sensible and the proposal that DMT is produced by brain or some other parts of body looks more reasonable. Biology does not usually manufacture anything without purpose. Especially so, if the manufacturing process requires metabolic energy. The biosynthesis of DMT from tryptophan does not occur spontaneously and requires N-methyltransferase enzyme as a catalyst. Also the highly non-trivial positive effects of DMT on consciousness suggests that it cannot be waste.

To understand what the purpose of DMT could be, one must have some idea about sensory perception in TGD Universe (I have already earlier written about DMT and psychedelics [L18] (see <http://tinyurl.com/ycualn43>).

1. TGD view about sensory perception relies on the idea that sensory qualia are at the level of sensory organs: this view makes sense if one accepts macroscopic quantum coherence [L35] (see <http://tinyurl.com/yb99u6u8>). TGD based view about time (zero energy ontology (ZEO)) allow to circumvent basic objections such as phantom leg: pain in phantom leg would be sensory memory of pain and in geometric past when the leg still existed. These sensory memories can be produced by stimulating temporal lobes in any subject person. One also avoids the challenge of explaining why structures consisting of essentially identical neutrons can produce so different sensory qualia.
2. This model however requires virtual visual feedback from brain realized as dark photons, which leak to ordinary photons identifiable as biophotons with energied in visible and UV range. The presence of virtual visual input could explain why the retina has inverted structure not expected in engineerish thinking.

Sensory percept would be an artwork created by the perceiver. This conforms with the fact that when congenitally blind people receive their vision, they report only seeing of diffuse light. The percept would be a standardized sensory mental images emerging as an outcome of iteration in which dark photons signals travel forth and back and give rise to a pattern recognition by transforming sensory input to standardized input nearest to it.

3. Dark photon signals would travel along magnetic flux tubes between brain to sensory organs and even between brain and magnetic body (MB) in much longer scales. Flux tubes would give rise to a connection network analogous to a telephone network. This network would have permanent part and dynamical part consisting of switches allowing to connect two flux tubes to single flux tube by a short bridge. Information molecules such as neurotransmitters,

hormones, and messengers could act as switches/bridges: when the information molecule attaches to a receptor, the bridge is formed and signals can propagate.

Also nerve pulses could induce flux tube bridges between neurons of the neuronal pathway by using neurotransmitters and learning as amplification of synaptic connections would be essentially the gradual stabilization of these flux tube bridges. Nerve pulse patterns need not serve as communications inside brain but could only make possible communications in much shorter time scales using dark photons. For 1 meter long axons about million forth and back signals are possible during millisecond.

Nerve pulses would however frequency modulate Josephson radiation from the generalized Josephson junctions defined by membrane proteins serving as ion channels. This modulation would code nerve pulse patterns to signals to MB mediated by EEG: EEG could also have fractally scaled variants corresponding to various layers of MB. This would explain the function of EEG.

4. Virtual sensory input need not always end up down to the sensory organs: there would be some kind of blocking stopping the virtual sensory input to higher level so that one would have only almost sensory percept: an imagined sensory experience. The virtual sensory input associated with imagination could proceed along different route than that associated with the buildup of percept. Also imagined motor actions would be halted motor actions. During REM sleep the blocking would not be present and the virtual sensory input would enter to sensory organs, in particular retina.
5. Pineal gland represents a kind of photoreceptor, “third eye”, which still serves as eye in some animals. Could the dark photons involved with imagination be received in pineal gland. Could they continue to travel to sensory organs during dreams and hallucinations? Pineal gland would be an organ of imagination besides serving as seat of soul! What is nice from the point of view of biological economy is that pineal gland would not be useless evolutionary remnant but would have found a new function.

Accepting this schematic view one can ask about the possible function of DMT.

1. DMT molecules could make possible REM dreams by providing the bridges making possible the propagation of dark photons to the retina. Pineal gland would be the natural relay station. Same mechanism could work for other sensory modalities if dark photons mediate the virtual sensory input transformed to ordinary percept at sensory organs. Also hallucinations would rely on this mechanism.
2. MB has very large layers, there is even evidence that galactic magnetic field is in contact with personal MB (personal MB could have flux tubes inside flux tubes of galactic magnetic field). Since magnetic field in Maxwellian world extends to infinity and since in TGD systems have field identity (field body/MB), one can even image that there are connections to distant civilizations with very weak magnetic field strengths at corresponding flux tubes carrying dark matter.

These connections could make possible a genuine sharing of sensory experiences and the encounters with ETs and alike could be genuine remote meetings! We might have these encounters during sleep quite routinely but would not remember anything since the sensory information would stop at the third eye! Only during dreams situation might change but also now sensory input would be virtual and represent imaginations.

**Remark:** I have told many times that I am working intensely and close my eyes lightly, I see a dim flow consisting of points and resembling an incompressible hydrodynamic flow. There are vortices and the flow goes back and forth. The flow lines are mathematically equivalent with field lines of a magnetic field in Maxwell’s theory and in TGD with flux tubes of MB in 1-1 correspondence with the points of the flow. Could this be seeing MB with the “third eye”?

### 3.3 The Interpretation Of My Own OBE Type Experiences In Terms Of The Proposed Model

My own personal experiences have served as a test bed for the basic ideas of TGD inspired theory of consciousness. I find it practical to divide these experiences into two classes. The first class of experiences have repeated relatively often during years after the great experiences. The Great Experiences in turn involved a rich spectrum of experiences which I group into the second class. There is some overlap between these categories.

#### 3.3.1 Visual Experiences And Kinesthetic Sensations

The first class of strange experiences involves several kinds of visual experiences and kinesthetic sensations.

1. When I lightly close my eyes during ordinary wake-up consciousness and in calm state of mind, I see dimly a complex flow in the visual field. This flow brings in mind time dependent magnetic field or incompressible flow of fluid. The direction of flow can be either inwards or outwards and can change. The flow can be also colored. The straightforward interpretation would be as a visual stimulus from the magnetic body which does not give rise to concrete images.
2. I have had many AS experiences in which I have seen my body in strangely deformed state and have had a sensation of floating. This experience is often followed by the experience of raising to the roof and I have made attempts to test whether the levitation is real or not. The experiences have ended to a wake-up to ordinary state of consciousness. Quite concrete sensations of what I have identified as “electrical storms in temporal lobes” have often accompanied these experiences.
3. I have had also flying experiences: typically there is some critical height which I cannot exceed. I have had also experiences about being in completely dissipation free spinning or translational motion, which bring strongly in mind what purely quantal motions of this kind feel like. The translational motion has been possible only in a finite volume defined typically by the walls of the room. I have also experienced my children to bring me back when I have tried to go too far. A possible interpretation is that my magnetic body is bound to that of room so that it is not possible to leave it.
4. I have often experienced quite concretely a return to my own body during wake-up as a kind of contraction somewhat like djinn returning to a bottle. After a visit to Holland where I was subject to a treatment by a healer, I waked up to a rather long-lasting experience in which I felt that the entire room was part of my body. The world around me was strangely peaceful and calm, somewhat like the world in the pictures I saw in fairy tales in my childhood.
5. Two illusions analogous to train illusion but involving a 2- or 3-dimensional wave motion instead of linear motion deserve also to be mentioned. I sat in a calm state of mind on cliff on beach and enjoyed looking the waves. Suddenly I got a long lasting sensation that the cliff is in a wave like motion as if I had seen the cliff from the perspective of the moving surface of sea and thus in a wave like movement with respect to it. The explanation would be magnetic body began to mimic the wave motion somewhat like a person listening very attentively begins to mimic the facial expressions of the speaker. Since magnetic body also serves also the dual role of a sensory canvas to which sensory mental images are projected [K45], the situation would be like projecting sensory mental images to a deformable screen along which deformation waves propagate. The projected sensory images such as the visual image about cliff would inherit the wavy character.

Anyone who has enjoyed free floating in a windy sea for a sufficiently long time has probably experienced a sensation about a wave like motion inside the body after the return to the shore. The sensation continues surprisingly long time. As far as I can remember, this experience is absent during free floating. Also this experience might relate to the fixation of bodily attention to the

wavy sea inducing a mimicry of wave motion by a relevant magnetic body as in the previous case and continuing for a considerable time after the return to the shore. During free floating in sea this sensation is weak since the relative motion is minimal but at the shore the situation changes since the body is in a relative 3-D motion with respect to the magnetic body.

### **3.3.2 OBE Type Auditory Sensations**

Also OBE type auditory sensations have often occurred.

1. The AS experience have often started usually by a gradual amplification of sounds such as the sound of refrigerator and have involved the rather frightening sensation that the refrigerator attracts me towards it and wants to fuse my self with its own (for this reason I have been forced to minimize this sound). A possible explanation is that magnetic body in this kind of situation contributes to the auditory stimulus the secondary sound representing the sensory stimulus that it has received from the body and a positive feedback loop is generated. Representation as microwaves is perhaps the most plausible option.
2. When I wake up during night-time, I can sometimes hear a kind of wind blowing and often I realize that ordinary wind is not in question when I see that there is completely calm outside. This wind has preceded sometimes a loss of consciousness. A microwave stimulus arriving from magnetic body along magnetic flux tubes and transformed to auditory sensation could be in question. Obviously this sensation would be direct auditory counterpart for the flow in visual field experienced during wake-up.
3. To listen one's own snoring during sleep or just before wake-up as an outsider is a rather bizarre experience and often it takes time to realize that it is really me. The interpretation in terms of microwave dark photon beams modulated by the snoring and reflected back from the magnetic body would be the simplest one.
4. Sometimes I also hear my own breathing as double with a time laps of a fraction of second between the copies. This gives some idea about size of the magnetic body possibly involved. For microwave hearing the size of magnetic body would correspond to a wavelength of typical EEG wave and would be of the order of Earth circumference for 7.8 Hz. If ordinary sound waves are in question the size of magnetic body involve would be of order 10 meters.

## Chapter 4

# TGD inspired view about remote mental interactions and paranormal

### 4.1 Introduction

The latest TGD inspired articles related to quantum biology, quantum mind, and remote mental interactions were published in JNLRMI around 2003. Several new ideas related to basic TGD, TGD inspired quantum biology and theory of consciousness have emerged during the subsequent 8 years. The article *Evolution of TGD* [L11] provides a short summary about the development of idea. The general vision is that both biology, consciousness, and remote mental interactions and related phenomena labelled as paranormal are predicted to share the same basic mechanisms, and that the proposed vision provides basic concepts and the language allowing to speculate and build simple models. One cannot of course take the proposed models too seriously at the level of details.

My original intention was to write just single article trying to give a summary about the progress of quantum TGD first and after that I will discuss the implications for quantum TGD based view about biology, consciousness and remote mental interactions and related mysteries. It however turned out that book would provide a more concise a more appropriate way to represent the overall view. One cannot of course take the proposed models too seriously at the level of details.

This is the first part of an article devoted to remote mental interactions. In the first part of the article I will summarize the new ideas that have emerged since 2003, the basic problems and basic ideas, and what parapsychological phenomena are at general level. The is also a more detailed representation at my homepage [K100] as a chapter of a book.

In the second part of the article I will discuss some applications of the basic vision. The notion of conscious hologram is discussed from the point of view of remote mental interactions. The notion of magnetic body is in decisive role as it is also in the understanding of quantum biology in TGD framework.

TGD inspired model for OBEs relying on the notion of magnetic body is summarized. The idea is that OBEs could correspond to sensory experiences assignable to magnetic body rather than real body. Also the connections with the work of other researchers, such as Shnoll, Persinger, and Tiller are discussed briefly. The challenge of testing the vision is also considered.

The appendix of the book gives a summary about basic concepts of TGD with illustrations. Pdf representation of same files serving as a kind of glossary can be found at <http://tgdtheory.fi/tgdglossary.pdf> [L15].



## 4.2 Brief Summary Of The Basic Vision Around 2003 Compared With The Recent Situation

To get perspective it is perhaps good to briefly summarize the basic vision about TGD inspired model for biology and consciousness as it was around 2003 according to the articles published in JNLRMI (see <http://tinyurl.com/me77ur>). The recent view about TGD inspired theory of consciousness is described in the chapter *Matter, Mind, Quantum* of the book “TGD Inspired Theory of Consciousness” [K50]. The general vision was that both biology, consciousness, and remote mental interactions and related phenomena labelled as paranormal are predicted to share the same basic mechanisms, and that the proposed vision provides basic concepts and the language allowing to speculate and build simple models. One cannot of course take the proposed models too seriously at the level of details.

Several new ideas and concepts have emerged since 2003.

The most important ones are following.

1. ZEO giving justification for notions like negative energy photons propagating to the geometric past and the notion of causal diamond (CD) providing embedding space correlate for the notion of self and predicting a hierarchy of fundamental time scales and predicting a connection between biology and elementary particle physics.
2. Hierarchy of Planck constants (see <http://tinyurl.com/y7c8e6x8>) [K33] giving rise to phases behaving as dark matter and suggesting the identification of living matter as ordinary matter controlled by dark matter in this sense.
3. The identification of ATP as a correlate of negentropic entanglement (see <http://tinyurl.com/yd7j9f5j>) and information theoretic interpretation of metabolism [K43].

### 4.2.1 TGD Inspired Theory Of Consciousness

The article *TGD inspired theory of consciousness and biosystems as macroscopic quantum system* (see <http://tinyurl.com/yaxe23ce>) [L4] describes the basic assumptions and ideas TGD inspired theory of consciousness and of quantum biology. The basic vision is essentially now although some simplification has taken place and the picture has become more detailed.

1. TGD inspired theory of consciousness can be regarded as an extension of quantum measurement theory by raising the observer from a status of something external to the Universe able to only induce state function reductions (in von Neumann’s view) to something described by quantum physics. The crucial almost paradox like problem is the conflict between the determinism of Schrödinger equation and non-determinism of state function reduction. Similar closely related problems relate to the relationship between experienced time and the geometric time of physicist. Whatever the theory of consciousness is, it must solve these problems.
2. Quantum jump as a moment consciousness, self as sequence of quantum jumps somehow integrating to a flow of consciousness, self hierarchy, and the identification of sub-selves as mental images of self, represent the basic identifications. It seems possible to reduce self hierarchy to a hierarchy of quantum jumps: higher levels of self hierarchy would be analogous to bound states of elementary particles and self hierarchy would relate closely to the corresponding hierarchy at the level of physics.
3. Quantum classical correspondence requires space-time correlates for selves. Space-time sheets are natural correlates of selves at space-time level. At embedding space level so called causal diamonds (CDs) introduced after 2003 in the context of zero energy ontology define this correlates. At the level of “world of classical worlds” ( WCW ) the correlate is sub- WCW assignable to the CD.

The notion of many-sheeted space-time forces to modify the notion of sub-system. Flux tubes connecting space-time sheets are natural correlates for entanglement. It is possible for space-time sheets without flux tube connections to contain topologically condensed space-time

sheets which are connected by flux tubes although space-time sheets. This would correspond to a situation in which two selves are un-entangled but possess sub-selves which are entangled. The notion of finite length scale resolution is essential for this definition to make sense. This leads to the idea about sharing of mental images by quantum entanglement producing what might be called stereo consciousness.

4. The possibility of quantum jumps and state function reductions occurring in quantum parallel manner is also something new and also relates to the many-sheeted space-time: see the article *Biosystems as macroscopic quantum systems* (see <http://tinyurl.com/y7m9g4n6>) [L1]. The quantum jumps taking place at the scales of sub-selves and their sub-selves could give rise to the experience of a flow of subjective time. One must be however very cautious with this concept: it is not possible to be conscious about not being conscious so that continuous flow of subjective time might be an illusion perhaps created by the model of self as a continuous narrative. At the fundamental level there might not be continuous narrative. Already dreams represent states of consciousness in which this narrative is only piecewise continuous.
5. The identification of quantum jump as relating entire deterministic *quantum histories* as analogs of solutions of Schrödinger equation solves the problems related to the conflict of non-determinism of state function reduction and determinism of Schrödinger equation and classical field equations which in TGD framework define an exact part of quantum theory. Quantum measurement theory involves also the notion of classical variables. These can be identified as zero modes which by definition do not contribute to the metric of WCW and are therefore not quantum fluctuating variables. The entanglement between zero modes and quantum fluctuating degrees of freedom must be fundamental element of state function reduction and also sensory perception and conscious choice.
6. p-Adic physics as physics of cognition [K59] is a central element of this picture and forces a generalization of number concept. Reals and p-adic numbers characterized by prime  $p = 2, 3, 5, \dots$  are completions of rationals and one can glue reals and p-adic numbers and their extensions along rationals and common algebraics to form a book like structure. The notion of adèle (see <http://tinyurl.com/yc6zy7sf>) - well-known to mathematicians - seems to catch quite well this vision [K61].
7. *Negentropy Maximization Principle* (NMP) [K52] defines the basic variational principle of TGD inspired theory of consciousness and states that the gain of conscious information in quantum jump is maximal. There are variants of NMP depending on what one means with quantum theory.
  - (a) For the ordinary definition of entanglement entropy this means that the two systems involved become un-entangled. Interpreting the density matrix as fundamental observable this gives standard quantum measurement theory.
  - (b) The introduction of hyper-finite factors of type  $II_1$  strongly suggested by the fact that WCW spinors correspond to this kind of von Neumann algebras leads to a further modification of measurement theory since state function reduction to a one-dimensional ray of Hilbert space is not possible in general but always happens to an infinite-dimensional sub-space (in the ordinary sense of the word). The state spaces can of course contain factors of type I for which ordinary measurement theory applies.
  - (c) For rational or even algebraic entanglement coefficients the entanglement entropy can be defined using p-adic norm for some p-adic prime  $p$  and can be negative and always is for certain primes  $p$ . Entanglement would carry genuine information and is expected to be stable under NMP. This leads to the vision about negentropic entanglement as a basic characteristic of living systems.

At space-time level one can also say that the - in general discrete- intersections of real and p-adic partonic 2-surfaces consisting of rational (or more generally, points in some extension of rationals) defined cognitive representations in the intersection of cognition and matter. This discretization would directly correspond to the fact that all cognitive representations have finite resolution and are necessarily discrete: computation represents a basic example of this. At more abstract level the partonic 2-surfaces represented

by algebraic equations making sense both in real and p-adic sense can be said to belong to the intersection of matter and cognition and represent living systems. Quite surprisingly, the art of algebraic geometry which typically involves counting the numbers of rational points of algebraic surfaces would directly relate to fundamental biology!

The basic implication of this vision is the necessity to re-consider the existing views about the relationship between subject and geometric time. I summarized the ideas about time as they were around 2003 in the article *Time, space-time, and consciousness* (see <http://tinyurl.com/yavkn2q7>) [L5]. There were several poorly understood issues and some of these issues are still far from well understood.

1. What is the precise relationship between geometric time and experienced time? How the experience about continuous flow of time emerges? (Is it an illusion: one cannot be conscious about being not conscious, dark moments of visual perception). What induces the arrow of psychological time inducing the apparent arrow of geometric time? Why the contents of sensory experience are restricted to so narrow a time interval whereas the contents of memory come from much larger space-time region. Note that the interpretation of the correlate of self as 4-D space-time regions provides a new vision about memory.
2. In the article *TGD inspired theory of consciousness* (see <http://tinyurl.com/y9bne6cc>) time-like entanglement and signals proceeding in the reversed direction of time was suggested to provide the basic mechanism of memory, intentional action, and (remote) metabolism. Libet's paradoxical findings about strange time delays of consciousness provide the basic support for this vision. The challenge is to give a more precise mathematical content for the notion of negative energy signal propagating backwards in time. Phase conjugate laser wave was proposed as its physical analog. The basic question is to understand how the arrow of geometric time emerges so that one can use these terms.

In TGD framework the notion of many-sheeted space-time challenges the notion of subsystem. One must also give a more precise mathematical content to the notions of U-process, state function reduction, and state preparation.

1. Quantum jump should consist of unitary process characterized by a unitary matrix  $U$  followed by a state function reduction in turn followed by state preparation. State function reduction should be a cascade like process proceeding from top to bottom as a splitting of systems to pairs of unentangled subsystems until negentropic or bound state character of entanglement does not allow splitting anymore [K52]. The identification of the unitary process  $U$  and  $U$ -matrix remained however open questions at that time. ZEO leads to a rather detailed minimal vision about what happens in quantum jump [K6].
2. What happens in quantum measurement? Non-quantum fluctuating zero modes of "world of classical worlds" (WCW) correspond to classical degrees of freedom in TGD and are excellent candidates for classical variables of quantum measurement - such as direction of the point of some "meter". With these zero modes quantum fluctuating degrees of freedom must entangle before state function reduction and measurement must induce state function reduction eliminating entanglement unless it is negentropic. Does state function reduction follow from macroscopic character of zero modes in the sense that there would be analogy with spontaneous magnetization which also selects single direction of magnetization rather than their quantum superposition.

And what is the role of cognition interpreted in terms of p-adic space-time sheets? Is p-adic-real algebraic entanglement carrying negentropy involved? At what level the state function reduction inducing a sequence of state function reductions in the sequence of entangled systems does take place: does the primary reduction take place at the level of cognition?

Their answers to these questions are still more or less guess work.

#### 4.2.2 TGD Inspired Quantum Biology

Many ideas about basic mechanisms of quantum biology already existed around 2003. Mention only the notion of magnetic body and the hypothesis that living matter resides in the intersection

of real and p-adic worlds implying that negentropic entanglement (see Fig. <http://tgdtheory.fi/appfigures/cat.jpg> or Fig. ?? in the appendix of this book) is a fundamental characteristic of living matter.

The assumption that living matter is ordinary matter controlled by dark matter - identified as a hierarchy of macroscopic quantum phases labeled by the value of Planck constant coming as integer multiples of ordinary Planck constant - has allowed to find a more detailed formulation for these intuitive ideas. The alert reader has perhaps noticed that the hierarchy of Planck constants and negentropic entanglement seem to provide two different ways to realize macroscopic quantum coherence. Are these two realizations independent of each other and if not, how do they relate to each other? This remains an open question to high extent.

1. High  $T_c$  super-conductivity was assumed to play a key role in living matter but the precise mechanism of super-conductivity was poorly understood. For the views at that time see the articles *Biosystems as macroscopic quantum systems* (see <http://tinyurl.com/y7m9g4n6>) [L1] and *Quantum model for sensory receptor* (see <http://tinyurl.com/y7opejka>) [L3].

A detailed model for high  $T_c$  bio-super-conductivity was however lacking. The hierarchy of Planck constants allows to construct this kind of model [K14, K15] applying also in the case of ordinary condensed matter systems. Rather remarkably, dark electrons at magnetic flux tubes play a key role in this model. Also negentropic entanglement could stabilize Cooper pairs.

Another new element not present at the time of writing of these articles is the new physics model of cell membrane (see <http://tinyurl.com/y7vahkzg>) as almost vacuum extremal of Kähler action [K37] motivated by quantum criticality and the expectation that large values of Planck constant correspond to almost vacuum extremals if one accepts the TGD based explanation for the hierarchy of Planck constants as a result of dynamics rather than something fundamental. It must be emphasized that the existing high precision determinations of Planck constant do not exclude the hierarchy since they do not detect dark matter. This leads to a picture about cell membrane as an analog of computer monitor with lipids representing pixels to which one can attach various qualia. These qualia need not however correspond ours which are assigned to sensory receptors.

2. In the article *Manysheeted DNA* (see <http://tinyurl.com/yczh88ss>) [L2] several ideas related to DNA were discussed.
  - (a) Homeostasis in many-sheeted space-time roughly states that supra currents at super-conducting space-time sheets determine the dynamical equilibria also at the space-time sheets containing ordinary matter. The strange findings about the behavior of cell membrane ionic currents support this hypothesis (they are quantal and flow even in absence of metabolic energy feed suggesting that Josephson currents are in question).
  - (b) Quantum spin glass degeneracy generalizing ordinary 3-D spin glass degeneracy to 4-D one meaning that strict determinism breaks down to piecewise one. Hence not only quantum states but also quantum jump sequences and therefore conscious experiences should have space-time correlates. These correlates would relate to conscious experience like written text to conscious thoughts and would provide a kind of feedback essential for symbolic memory. 4-D spin glass degeneracy provides also a justification for the hierarchy of Planck constants.
  - (c) A further key idea was healing by time reversal. The idea is that the reversal of the arrow of geometric time implies that second law holds in opposite direction of geometric time so that basically entropic process looks like negentropic one. Also the notion of magnetic mirror, topological self-referentiality, the identification of information molecules as quantum links in quantum web, the idea about molecular recognition mechanisms, the connection between metabolism and generation of quantum coherent states, scaling law of homeopathy were further ideas discussed in the article.

The developments since 2003 have enriched this picture with several new ideas.

- (a) ZEO and the notion of CD allow to assign the arrow of geometric time directly to the zero energy states rather than their dynamics. Dark matter as a hierarchy of phases with large value of Planck constant can be identified as controller of ordinary matter in living systems, and negentropic entanglement assumed to have ATP as a correlate allow to a more detailed articulation of these ideas.
  - (b) The idea about DNA as topological quantum computer [K3] with braids realized as magnetic flux tubes connecting DNA nucleotides with lipids of cell membrane is another key idea and means that DNA becomes the hardware of quantum computations with software represented by the braidings of flux tubes.
3. The article *Macrotemporal quantum coherence, quantum spin glass degeneracy, and number theoretic information concept* (see <http://tinyurl.com/y7wlrzmo>) [L8] described the vision about living matter as a macroscopic quantum system. The notion of negentropic entanglement and the idea about life as islands of rationality in the oceans of real and p-adic continua was described already in this article.
  4. The article *Biosystems as conscious holograms* (see <http://tinyurl.com/yb79md6j>) [L7] develops the idea about living matter as conscious hologram. One of the key mechanisms was time mirror mechanism (see **Fig.** <http://tgdtheory.fi/appfigures/timemirror.jpg> or **Fig. ??** in the appendix of this book) finding a justification in ZEO. A model of remote mental interactions and an model inspired by the findings of William Tiller was proposed with key role played by the notion of magnetic body able to receive information from and control even in-animate matter. ZEO provides first principle justification for the time mirror mechanism.

The vision was applied to develop a model of bio-photons. The (see <http://tinyurl.com/y7vahkzg>) model of cell membrane (see <http://tinyurl.com/y7vahkzg>) as almost vacuum extremal, which emerged later, led to a radical proposal: bio-photons are nothing but large  $\hbar$  EEG photons which have suffered an energy conserving phase transition reducing the value of Planck constant to ordinary one.

5. The article *Quantum model for nerve pulse, EEG, and ZEG* (see <http://tinyurl.com/y842gm3w>) [L6] describes a TGD inspired view about nerve pulse and EEG. I would not speak about *ZEG* in the title now since the status of  $Z^0$  radiation fields is still uncertain (classical  $Z^0$  fields are however in an essential role in the model of cell membrane and sensory receptor).

Electronic super-conductivity and possibly super-conducting states assignable to biologically important ions are key elements of the model but the model of electronic super-conductivity was not convincing: it was assumed that super-conducting space-time sheets are at very low temperature. The model of electronic super-conductivity was not too convincing at that time and considerable progress has taken place with the advent of the hierarchy of Planck constants [K14, K15].

In case of biologically important ions it had already become clear that “TGD inspired nuclear physics” [K56] allows fermionic nuclei with given charge to have bosonic companions with the same charge and therefore same chemistry. This would make possible to assign Bose-Einstein condensates and super-conductivity even to atoms which are chemically equivalent with fermionic atoms.

EEG and its possible variants were identified as communications and control tools mediating sensory information to the magnetic body and allowing magnetic body to quantum control biological body. This means the presence of a completely new level in biological information processing. Again the hierarchy of Planck constants plays a key role in making possible for ELF photons with extremely small energy to have energies which are above thermal energy and thus have biological effects and carry information [K29, K77].

The aim of this chapter is to describe in some detail the recent view about remote mental interactions. Also connections with the work of other researchers are summarized.

### 4.3 Basic Questions And Basic Ideas

The basic ideas of TGD inspired model for remote mental interactions and related phenomena such as OBEs and near death experiences are summarized in the chapters *Quantum model for paranormal phenomena* (see <http://tinyurl.com/y8fc7zn4>) [K75] and *TGD based model for OBEs* (see <http://tinyurl.com/y797h78x>) [K95] of the book “TGD Inspired Theory of Consciousness”. Also the chapter “Bio-systems as conscious holograms” [K12] (see <http://tinyurl.com/ydx4fuk5>) contains a summary of a model for how conscious hologram might allow to understand remote mental interactions, and TGD based view about the work of William Tiller related to intentional imprinting. The chapter contains also a section about bio-photons: there could be a connection with remote mental interactions since bio-photons could result from the transformation of large  $\hbar$  dark photons by a phase transition reducing the value of Planck constant, which in turn would be essential for communications between biological body and magnetic body.

I have not worked with this topic during last years, and I apologize for my very restricted views. The most important new ideas relate to the notion of magnetic body, ZEO, negentropic entanglement, and dark matter hierarchy. It would be interesting to deduce explicitly the implications of new ideas that have emerged since 2003 but the following discussion is just a commentary.

#### 4.3.1 Basic Questions

The general idea is that remote mental interactions are by no means paranormal in the sense that they would be in conflict with well-established laws of physics, as skeptics want to see them. Our personal magnetic bodies apply remote mental interactions to receive communications from biological body and to control it routine. Remote mental interactions having living matter as a target would correspond to a situation in which the personal magnetic body of operator is able to receive information from the biological body of target or control it. Becoming possessed would be one manner to say this. Hypnosis would represent the basic example of this. The target could be also water perhaps containing some organic matter as in Tiller’s experiments. Also psychokinesis acting on inanimate targets such as computers can be considered but in this case the mechanisms of remote mental interaction cannot be quite same as in the case of biological targets.

The basic question is why the remote mental interactions having living target are so rare if they apply same mechanisms as living matter in general. A possible reason is that living matter has developed an immune system preventing the situation in which the organism becomes possessed. This would be very similar to what has taken place in the evolution of computers. The restriction of communication windows to narrow frequency ranges depending on species and even individual, and the counterparts of passwords realized as temporal field patterns could make this kind of immune system possible. Cyclotron frequencies would be central here and hierarchy of Planck constant would allow arbitrary low frequencies with energies below thermal energies at physiological temperature range. The first guess is that passwords using genetic code so that communications restricted to those occurring between the members of the same species become possible. The challenge is to invent plausible physical realizations for the passwords. One possible proposal inspired by the experiments of Gariaev and collaborators would realize the values of bit as two orthogonal photon polarization directions. Another realization would be in terms of a collection of frequencies interacting resonantly with the target DNA and inducing gene expression: no explicit knowledge of address of the target would be needed.

Second basis problem in many remote mental interactions such as the intentional effect on random number generator is “Who knows how?”. How the mere intent can be transformed to action without any knowledge about the details of the action? The attempt to understand how neuro-feedback affect the behavior of single neuron leads to the same question.

1. Magnetic mirrors make possible also feedback and this feedback could make possible learning. For instance, in psychokinesis (especially so in micro PK), this learning would be crucial and analogous to that what occurs when we learn to drive a car. In healing this kind of feedback might help to find the healing frequency by trial and error.
2. It is quite possible that also multi-brained and -bodied higher level collective selves actively participate in the process as a third party such that the remote mental interactions would act as a relay states. I have suggested similar explanation for Sheldrake’s findings about

learning at the level of species and Tiller's findings about the "transfer of intent". This could make possible coherent amplification effects (TEM, prayer groups) and could make available information resources of all brains involved with the group. This could for instance explain the ability of a remote viewer to see an object on basis of data which need not have any meaning for her.

3. A fast amplitude modulation of alpha waves introducing higher harmonics to the carrier wave is a good candidate for mediating communication between brains and higher level multi-brained selves. Mesoscopic "features" in brain involve precisely this kind of amplitude modulation and might represent just this kind of messages. Interestingly, also speech is produced by a fast amplitude modulation of 10 Hz basic vibration frequency of speech organs (assignable to electron CD as a fundamental frequency) and kHz (quarks) frequency is a special frequency from the point of view of hearing.

Third key question relates to the metabolic aspects of remote mental interactions. One expects that negentropic entanglement between operator and target is involved. The hypothesis about the presence of ATP molecule at the magnetic flux tube connecting operator and target as a prerequisite for negentropic entanglement would reduce the energetics of remote mental interactions to basic metabolism. This allows to make quite strong conclusions about the character of these interactions. Here one must however remember that earlier model assumed much more general mechanism of metabolism involving transfer of particles to larger space-time sheets liberating or using zero point kinetic energy in this manner. It could be part of  $ATP \leftrightarrow ADP$  mechanism or completely independent mechanism utilized by the prebiotic metabolism. It could be also involved with the remote mental interactions for which targets are in-animate.

Fourth question relates to mechanisms and here time mirror mechanism involving sending of negative energy photons to geometric past is the natural candidate for both intentional action, remote metabolism, and memory. Also its counterpart involving sending of positive energy signals to future can be considered. It must be emphasized that the reflection need not always occur. The negative energy photon could be just absorbed without any signal generated and this leads to ask what happens in the case of memory.

### 4.3.2 Key Ideas Of The TGD Inspired Model Of Remote Mental Interactions

During years a rather concrete TGD inspired model of remote mental interactions has developed.

1. The basic notions of the TGD inspired model are magnetic body as an intentional agent controlling biological body and receiving data from living body or even "dead" matter system with massless extremals (MEs) mediating these communications, zero energy ontology and the related notion of causal diamond (CD) serving as an embedding space correlate of self and assigning to elementary particles fundamental macroscopic time and length scales as those of CD, the hierarchy of Planck constants making possible macroscopic quantum phases and zoom-ups of quantum systems, and the vision about living matter as something residing in the intersection of real and p-adic worlds and the closely related notion of negentropic entanglement crucial for the functioning of living matter and conscious intelligence in TGD Universe. Note that this means that life corresponds to number theoretical quantum criticality in a well-defined sense.
2. Zero energy ontology means a radical departure from standard physics. The creation of zero energy states from vacuum is possible and means that in principle (just in principle!) the claims of parapsychologists about ectoplasm and of yogis about the possibility to create of matter from nothing are consistent with the basic conservation laws of physics. In TGD inspired biology this process could take place routinely. Causal diamond is the embedding space correlate for the zero energy state. Positive and negative energy parts of the state reside at its boundaries. p-Adic length scale hypothesis and number theoretical vision suggest that the proper time distance between the tips of CD comes as powers of two. For electron and quarks playing key role in the model of DNA as topological quantum computer this

temporal distance would correspond to 1 second and 1 millisecond respectively suggesting a direct connection between elementary particle physics and basic bio-rhythms.

The translations and Lorentz transforms of CDs are also CDs and one can assign to CDs a moduli space further expanded by the introduction of the hierarchy of Planck constants. One expects that this moduli space is crucial for understanding of the geometric qualia [K76]. The communications between sub-selves would be naturally based on resonance. CDs are characterized by resonance frequencies which in the rest system of CD come as harmonics of the fundamental frequency determined by the proper time distance. This would allow a universal coding of geometric data using frequencies. Both MEs and CDs could be regarded as being analogous to music instruments and this in fact explains basic facts about music experience. These resonance frequencies should play a key role in biology and also in remote mental interactions- even those in which target consists of “dead” matter since fundamental bio-rhythms characterize also elementary particles in TGD Universe.

3. p-Adic physics as physics of cognition is an essential element of approach. Intentions are represented as p-adic space-time sheets. In the intersection of real and p-adic worlds these space-time sheets have a mathematical representation making sense also in real context so that one can say that these surfaces are in the intersection of real and p-adic worlds and the phase transitions transforming surfaces belonging to different number fields are possible. This makes possible transformation of intentions to actions and their reversals possible in the intersection of real and p-adic worlds.  $U$ -matrix indeed makes sense also for transformation representing the transformation of say p-adic space-time surface to a real one and is coded only by data assignable to the rational and common algebraic points of real and p-adic variants of partonic 2-surface [K52]. Note that zero energy ontology makes possible also the transformation of intentions to actions as p-adic-to-real phase transitions without breaking of the conservation laws.
4. Negentropic entanglement, which can be both space-like and time-like in zero energy ontology, makes possible quantum superposition of macroscopically different configurations of the target system correlated with the states of operator system. The operator should be able to achieve the negentropic entanglement and intentionally increase the amplitude of the desired outcome in this superposition. Negentropic entanglement need not involve binding energy and I have proposed this as a deeper level explanation for the nebulous notion of high energy phosphate bond crucial for metabolism in living matter. Quite generally, negentropic entanglement would make possible for the operator to transfer metabolic energy and momentum to the target. Remote healing involves often positive emotions like compassion and love suggesting that negentropic entanglement accompanies healing process. The hierarchy of values of Planck constant would make possible this process in long time and length scales.
5. Addressing of the target is key problem in remote mental interactions. Here password consisting of a collection of frequencies interacting resonantly with the DNA of living target and inducing remote gene expression dictated by the frequencies is one possibility. Gariaev's findings that scattering of red laser beam from DNA generates broad band of frequencies, which are biologically active, could be interpreted in this model. The photons would correspond to the same energy but wide range of frequencies corresponding to different values of Planck constant. These frequencies would define the address of the target, eventually some part of DNA inducing gene expression. The interaction would be by the superposition of the electric field of incoming radiation with the electric field of flux tube inducing the analog of Becker's healing current in turn loading metabolic resources and generating negentropic entanglement and also gene expression.
6. The notion of hologram is often used as a useful metaphor: Gariaev talks about DNA hologram and I have talked about conscious hologram. This notion obviously requires more detailed definition to be testable. What hologram does is that scattering of laser beam from it is effectively scattering from target. Magnetic flux tubes make TGD Universe an Indra's net: could it be that the scattering from object behaving like bio-hologram could actually take place from the target which it represents! Photons would travel from object to the target along flux tubes, scatter, and arrive along flux tubes and leave the object. The object,



which actually acts as a relay station, would define pseudo-hologram. Also frequency coding of the address could be combined with this picture if the lengths of flux tubes are multiples of wavelength (proportional for Planck constant).

### 4.3.3 Some Examples Of Remote Mental Interactions Interpreted In TGD Framework

Some examples about remote mental interactions with living target are in order.

1. In telepathy the communications from biological body of target would be based on EEG and its scaled analogs. Also ECG could be involved. In TGD Universe even electromagnetic field might be replaced with electroweak and color field below some scale in scale hierarchy defined by Planck constants.
2. In hypnosis magnetic body of operator would control the biological body of the target, which would be “possessed” and behave like a part of the biological body of operator.
3. It would be also possible to share sensory percepts and memories of the living target. The mechanism would be time mirror mechanism applying also to ordinary memory and sensory perception.

In the case of in-animate targets the modelling is not so straightforward. One could however assume that also now negentropic entanglement is involved and that the ATP of the operator is used. Note however the possibility of the more general mechanism at the end of the target.

1. In psychokinesis with inanimate target negentropic entanglement would be mediated by flux tubes containing ATP assignable to the operator. The metabolic energy of ATP of operator is transferred to the target. The increase in the rate of metabolism could therefore serve as a signature.
2. In the remote mental interaction with computer the intention is to affect the pattern of random numbers and the mere transfer of metabolic energy is not enough since the effect must also have a correct sign. The net effect is the change of the distribution of random numbers from expected and Tiller observes strange periodicities in the distribution. It seems that remote mental interaction must be able to affect the probabilities of the outcome so that they are not identical as randomness would require. What could be the mechanism? Direct entanglement with the representation of bits is not plausible. While writing this article it occurred to me that there might be a connection with the model for Shnoll effect [K5] which I developed for a couple of years ago and based on a deformation of probability distributions based on  $p$ -adic mathematics and quantum groups. What is remarkable is that the parameters characterizing statistical distributions vary slowly with periodicities assignable to the gravitational fields in solar system. Could it be that also the statistical effects of intentional action could be characterized by the same mathematics leading to purely number theoretical predictions? This will be discussed in more detail below.
3. In the intentional imprinting of Tiller creation of flux tubes connecting the magnetic body of operator and non-living target would take place. Intentional action induces changes such as change of pH and this could rely energetically on the use of ATP. Magnetic fields should be important and cyclotron frequencies might be important. When a sequence of random bits is used, periodicities with cyclotron frequencies are suggestive supporting the hypothesis involving magnetic flux tubes and Shnoll effect.
4. What could be the mechanism in the case of remote viewing? Magnetic body should receive from the target extrasensory input generating sensory percepts or more abstract cognitive mental images such abstract shape. Could the signal arrive from the target to the magnetic body of operator and therefrom to the biological body - maybe brain - of the operator to create genuine sensory percept? To have a genuine sensory percept back-projection to sensory organs is necessary and in TGD based model for sensory qualia the back projections to sensory organs are in a central role: the virtual world sensory input from brain and possibly from

magnetic body to sensory organs used to build standardized mental images. Or is there any creation of sensory percept?

5. In the case of precognition the situation is not at all clear. In ZEO based vision the simplest view is that the “upper” light-like boundary of CD corresponds to the seat of sensory percepts realized as mental images. Memories would correspond to information arriving from the geometric past inside CD. Precognition would mean receiving information from the geometric future of CD. Is this possible? How this would be realized. The vision about generalized Feynman diagrams suggests that given CD surrounds a vertex of generalized Feynman diagram in certain scale and that larger CDs are present and precognition would involve time reversed signals at the level of next CD. There presence of larger CD and longer time scale would mean that prophets are indeed “messengers of Gods”.

Why we do not remember the geometric future. Is the reason that the contents of conscious experience is about the boundary of CD which performs the state function reduction.

## 4.4 Parapsychological Phenomena

In this section various parapsychological phenomena are discussed in the general framework introduced in the previous section.

### 4.4.1 Extrasensory Perception, Precognition, And Other Parapsychic Effects

The general model for paranormal effects relies on same basic ideas as the model of quantum biology.

1. The transformation of p-adic [K59] space-time sheets makes possible the transformation of intentions to actions. Since p-adic space-time sheets have literally infinite size in real sense, distance does not matter. The set of points in the intersection of p-adic and corresponding real space-time sheet obeying same algebraic equations consists of rational and possibly also algebraic points common to real and p-adic variants of embedding space.

Parapsychological phenomena involve the transfer of information and negentropic entanglement makes possible genuine information at quantum level as also breaking of the second law of thermodynamics in the time scale of CD in question. Hence remote mental interactions should involve the generation of negentropic entanglement (see **Fig.** <http://tgdtheory.fi/appfigures/cat.jpg> or **Fig.** ?? in the appendix of this book) irrespective of whether the target is living system or consists of “dead” matter.

2. The idea about field body serving effectively as an intentional agent is second element of the model. The topological light rays representing negative energy signals propagating into geometric past created by a transformation of p-adic space-time sheet to a real one might be said to represent the “desire” inducing neural activities in the brain of geometric past. This mechanism provides not only a model for how magnetic body uses biological body as a motor instrument but also for PK.

MEs acting as bridges between different organisms would mediate em oscillations allow a directed transmission of smaller MEs behaving effectively as particles moving with light velocity. These MEs could be both real and p-adic and -using the terminology of Qigong practice- would represent qi (action) and yi (intention) respectively. An essential element would be resonance: sender and receiver in should be accompanied by MEs characterized by the same fundamental frequency: only these MEs could resonantly connect healer and healee. Healer must have ability to continuously vary the healing frequency.

MEs would naturally correspond to pairs of positive and negative energy space-time sheets. They would be attached to magnetic flux tubes and magnetic mirrors consisting of two flux sheets would make possible sensory-motor loop.

3. Zero energy ontology justifies the notion of negative energy signals and brings in also CDs as correlates of selves and natural fundamental targets of remote mental interactions. Zero energy ontology and the new view about time allows to assume that sensory qualia are at the level of sensory organ (objections such as phantom leg phenomenon can be circumvented) and that symbolic representations of objects of perceptive field and their attributes reside in brain.

Sensory input generates sensory representations based on real space-time sheets possibly accompanied by p-adic cognitive space-time sheets. Field body can share these mental images by quantum entanglement and also receive sensory information as classical signals involving using frequency coding and coding by temporal patterns. These latter representations would correspond to cognitive and emotional aspects associated with the sensory input. One could even say that higher level sensory representations are somatosensory experiences of field body. The intersection points of real and p-adic space-time sheet would determine the physical cognitive representation and would be always discrete. The analogy with the discreteness of numerics should be noticed. Since this model would apply also to extrasensory perception, the attribute “extrasensory” becomes somewhat misleading attribute.

4. Extrasensory perception could also result from the direct electromagnetic perturbation of the sensory magnetic canvas outside the body and the sounds generated by auroras and meteors might be genuine “extrasensory” perceptions of this kind [K77]. The frequency spectrum for the sounds produced by meteors and detected both sensorily and electronically in in the range 37 – 44 Hz [F3], which is the range of thalamocortical resonance frequencies associated with sensory representations in magnetic sensory canvas model. The sounds are several orders of magnitude more intense than they should be unless em perturbations propagate to Earth in a channelled manner. Only few meteors generate these sounds. These observations suggest that a resonant amplification of the em perturbations by magnetic mirrors of the sensory canvas channelling the em field to the surface of Earth are in question.
5. One might argue that if memes are not universal, remote cognition is not very useful. If memetic and genetic codes are realized in terms of CDs of quarks and leptons, one would have universality. If DNA double strand provides the relay station through which sensory input and motor output of the magnetic body flows, one would achieve universality of communication and control mechanisms at the level of living matter. An interesting question is whether memes are really species-specific as the morphic fields are in Sheldrake’s theory. The ability of shamans to transform at the level of conscious experience to animals suggests that this might not be the case. There is also a famous real life story about a student who spend several days in the experiential world of dog. Various identification phenomena would very probably involve also magnetic mirrors acting as bridges between say shaman and animal (or possibly multibody collective self defining “species self” ) and making possible to share the experience of animal. Same mechanism as in the case of long term memories would be in question but with personal memories being replaced with the experiences of another species.

The fact that p-adic space-time sheets have literally infinite size suggests that cognition and intentionality are cosmic phenomena and that there might be cosmic pool of shared cognitive mental images. Hence memes could be completely universal.

#### 4.4.2 Psychokinesis

One can classify psychokinesis to various types depending on whether the target is living or “dead” and whether the effect on target is a mere transfer of energy and momentum or control action involving information transfer.

Below I briefly discuss an early TGD inspired model of PK, a general model of PK assuming time mirror mechanism (see **Fig.** <http://tgdtheory.fi/appfigures/timemirror.jpg> or **Fig. ??** in the appendix of this book) of ordinary intentional action but applied by the magnetic body of the operator to a system different from the biological body, and a more specific model for machine-human interactions. Also concrete examples of various kinds of PK effects are discussed.

### A possible model for psychokinesis with non-machine targets

In [K112] a mechanism of psychokinesis based on the generation of wormhole magnetic field configurations making possible levitation was proposed. Although this mechanism was yet general it deserves a discussion and reader is recommended to see [K112] for details. Basic mechanism is the levitation of diamagnetic substances in an external magnetic field: the force results when the diamagnetic substance repels external magnetic field from its interior. The force is essentially the gradient of the net magnetic energy inside the volume defined by the object.

The mechanism is purely TGD based and relies on the generation of a pair of space-time sheets having opposite time orientations, and carrying opposite magnetic fields and opposite energy densities, and the subsequent interaction of the second space-time sheet with the object moved in the psychokinesis. Exactly the same mechanism applies in case of MEs (massless extremals) and could be used to generate coherent locomotion of organism resulting as a recoil effect when the second ME is absorbed by the body part. MEs provide a candidate for the mechanism of psychokinesis.

### TGD based general view about PK

A general TGD based explanation psychokinesis relies on the same fundamental mechanism as ordinary intentional action, long term memory, and remote metabolism. The model applies more or less as such also to telepathy and could also allow to understand the notion of water memory explaining homeopathic effects.

1. The basic mechanism of PK and retro PK relies on quantum jumps transforming the p-adic space-time sheets representing intentions to real space-time sheets representing desires represented as negative energy signals to the geometric past. These signals modify the output of say random number generator to a non-random one. Magnetic flux quanta would realize the bridges along with the negative energy signals would propagate. The mechanism would favor retro PK if the operator is in active role. Genuine PK is also possible but in this case target would be active sucking metabolic energy provided by the operator.
2. Negative energy signals could consist of dark phase conjugate photons or even massless  $W$  bosons since TGD allows scaled up variants of electro-weak gauge bosons with large Planck constant and arbitrarily small mass scales. Dark  $W$  bosons are especially interesting since they can induce charged entanglement and purely non-local charge transfer mechanism and have been proposed to play a key role in the generation of the nerve pulse.
3. Magnetic flux quanta are the bridges making possible (presumably) unconscious feedback so that the operator can unconsciously learn how to affect the machine. How intentions can have effect on system whose functioning is unknown to the operator is actually the basic mystery of, not only psychokinesis, but of remote healing and remote mental interaction in general, as also of the phenomena labelled as instrumental transcommunications (ITC). The learning by feedback, much analogous to that happens when we learn to drive bicycle, would solve this mystery. The effects of group activity could be understood if groups tend to form collective selves so that coherent amplification of the effect occurs.
4. The ability of the PK able person to imagine the desired effect is important and could correspond to the ability to generate p-adic space-time sheets representing the intention. The desire about the action represented by the corresponding real space-time sheet should induce the effect optimally. In personal discussions with a PK-able psychic I indeed learned that he always tried to imagine in every possible detail how he moved the physical object (say a box of matches). The role of imagination is important also in remote healing [J65]. Perhaps the p-adic pseudo constants made possible by the non-determinism of p-adic differential equations should be in a good approximation genuine constants.
5. The optimal targets are initial value sensitive- or more generally-critical.
  - (a) Quantum criticality is the basic characteristic of TGD Universe and the prediction is the existence of a hierarchy of criticalities. Number theoretical criticality would in turn characterize living matter and might be a characteristic of optimal targets.

- (b) Also quantum criticality in the sense that several values of Planck constant are possible with large values of  $\hbar$  assignable to negative energy signals mediating the desire of the PK-able person. PK requires energy and this favors systems, which can utilize standardized metabolic energy quanta liberated in the dropping of particles to larger space-time sheets.

In many-sheeted space-time particles topologically condense at all space-time sheets having projection to given region of space-time so that this option makes sense only near the boundaries of space-time sheet of a given system. Also p-adic phase transition increasing the size of the space-time sheet could take place and the liberated energy would correspond to the reduction of zero point kinetic energy. Particles could be transferred from a portion of magnetic flux tube portion to another one with different value of magnetic field and possibly also of Planck constant  $\hbar_{eff}$  so that cyclotron energy would be liberated. In the following only the “dropping” option is discussed.

- (c) Water would be an optimal system from the point of PK and retro PK. Homeopathy might indeed involve PK like aspects. Benveniste’s experiments [I14, I15] gave support for the notion of water memory but could not be replicated when the experimenters did not know in which bottles the treated water was. The preservation of water memories represented in terms of many-sheeted lasers for with  $1/0$  corresponds to a population inverted state/ground state, requires metabolic energy feed and the system might suck this metabolic energy from the biological body of the experimenter [K40].

6. As noticed, the proposed model is extremely general and seems to apply to almost any paranormal phenomena. For instance, the claimed re-incarnation experiences could be understood in terms of the general mechanism for long term memory. The person who remembers having lived in past could share mental images of a person in the geometric past by time like entanglement (episodal memory), or could be able to communicate with negative energy signals to the brain of a person on geometric past memory recall and thus receive declarative memories. It is quite possible that survival of fittest in our culture has led to an evolution of an immune system preventing sharing of mental images and communications with other brains.

### Machine-mind interactions

Machine-mind interactions represent a modern branch of parapsychological research and nowadays methodologically highly advanced. These interactions are studied several groups and individuals: mention only the Princeton Engineering Anomalies Research (PEAR), which is a group directed by Prof. Jahn, the Anomalous Cognition Project of Dick Bierman, and the retrospsychokinesis work of Helmut Schmidt. In the sequel some aspects of this work are discussed.

The generation of negentropic time like entanglement between operator and target leading to a superposition of pre-existing and desired zero energy states and a subsequent increase of the amplitude of the desired outcome could be the general mechanism of machine mind interactions. “Who known how?” is a highly relevant question in the case experiments involving the attempt of operator to affect the function of a machine like computer whose detailed functioning is not known for the operator. This question could have two answers. Either the operator learns to who to affect the outcome by the simple sensory-motor loop provided by MEs or there is third party who knows and corresponds to a higher collective level of consciousness.

#### 1. *Retro psychokinesis with random number generators*

The analysis of experiments [J23, J24, J19] discussed in the [K106] suggests that the geometric past can change in the time scale of a fraction of second. Both the work done at PEAR [J32] and the work of Helmut Schmidt with retro psychokinesis [J52] provide support for the change of the geometric past in much longer time scales. PEAR experiments demonstrate the anomalous effect also in the direction of future. For instance, the experiments of Schmidt done 1992 discussed in New Scientist [J56] demonstrate that martial art students were able to affect the visual display determined by pre-recorded random numbers. The probability for this kind of deviations from non-randomness was about 1/1000. Henry Stapp proposed an explanation for this in his paper published in Phys. Rev. A [J53] based on nonlinear quantum mechanics.

The change of also geometric past in the quantum jump between quantum histories implies the notion of a four-dimensional physical reality and forces to regard three-dimensionality of reality as illusion created by the 3-dimensionality of our sensory experience (recall the notion of the association sequence). This implies that our geometric past is changing all the subjective time and that communications to the geometric past and future are possible and are consistent with the weak causality violation hypothesis of Schmidt [J52]. What this hypothesis implies that in the newest quantum history generated by RPK all separate records contain the pre-recorded random numbers are altered in the same manner in RPK. Schmidt has tested weak causality hypothesis by using two separate cassette tapes containing the pre-recorded random numbers, one used in the PK experiment and another one kept locked in a safe. The records were indeed found to be identical after the experiment.

The results of Schmidt suggest also classical signalling to the direction of the geometric past. Real space-time sheets with negative time orientation could serve as the geometric correlates for these signals.

### *2. The work of Princeton Engineering Anomalies Research group*

The study of anomalies in human-machine anomalies provide a highly sophisticated and controlled manner to study psychokinesis in its various forms. For instance, in the experiments carried out in PEAR group (Princeton Engineering Anomalies Research) [J32] operators try to affect various kinds of electronic, mechanical, acoustical, optical and fluid devices. In unattended calibrations these devices yield random output whereas in the experimental situation operator tries intentionally to affect the output so that non-randomness results. Each input that operator tries to affect consists of 200 bits formed from a random physical signal and operator can have either the intention to increase the number of 1: s (high), the number of 0: s (low) or have no intention at all (baseline). Operators can exert their efforts from a distance of thousands of miles, before or after the the actual operation of the devices. Over the laboratory's 20-year history, thousands of such experiments, involving about 100 millions of trials, have been performed by several hundred operators.

The observed effects can be summarized as the average for the sum of bits which is 100.026 for high and 99.984 for low. The effect is by a factor 3.6 higher than the expected margin of error. Effects are thus quite small, of the order of a few parts in ten thousand on average, but they are statistically repeatable and compound to highly significant deviations from chance expectations. Effects are highly operator specific and there are significant disparities between male and female performances. The random devices respond also to the group activities of large numbers of people and are especially sensitive to the effect of small intimate groups, group rituals, sacred rites, musical and theatrical performances, and charismatic events.

Time mirror mechanism suggests the following model for the machine-human interactions encountered in say PEAR experiments.

1. The effect of intention could be on the generator of random noise, on bit sequence represented in the computer memory, or even on the recorded value of the sum of bits. A possible mechanism in the latter two cases is the reversal of electromagnetically represented bit.
2. The general mechanism of intentional action involves negative energy signals inducing a change in the charge distribution determining the value of bit. Negative energy photon could induce a dropping of ions to a larger space-time sheet. Also the emission of negative energy dark  $W$  bosons (appearing in TGD based model of nerve pulse) could induce a change in the net charge. In both cases the sign of charge would correlate with the character of intention and for the first mechanism there would be asymmetry between "high" and "low" (proton, electron).

### *3. The work of William Tiller*

[J87] [J87, J83, J84, J85] has performed experiments involving intentional imprinting of targets such as water. The model for the findings of Tiller is discussed in [K12]. The imprinting manifested itself as temporal and spatial oscillations of pH and temperature. The surprising finding was conditioning: also the air around intentionally imprinted device exhibited these oscillations. Also computer could be conditioned. The Fourier transform of the correlation function for bit

sequences of random number generator demonstrated peaks at harmonics of  $f = 1/T$ ,  $T = 113.778$  min.  $2^n$ -multiple of .1 seconds for  $n = 16$  would correspond to  $k = 143$  and  $T = 109.23$  minutes which is by about 4 per cent too small. The proposed assignment of cyclotron photons with motor action leads to ask whether large  $\hbar$  dark cyclotron photons with these frequencies could induce a periodic perturbation of the random bit sequence?

#### Could Shnoll effect and statistical effects of psychokinesis have common mathematical description?

In the remote mental interaction with computer the intention is to affect the pattern of random numbers and the mere transfer of metabolic energy is not enough since the effect must also have a correct sign. The net effect is the change of the distribution of random numbers from expected and Tiller observes strange periodicities in the distribution. It seems that remote mental interaction must be able to affect the probabilities of the outcome so that they are not identical as randomness would require. What could be the mechanism? Direct entanglement with the representation of bits is not plausible.

1. This brings in mind Shnoll effect [K5] in which probability distribution  $p(n)$  for an integer valued observable transforms from expected smooth distribution - say Poisson distribution - to a many-peaked distribution. The distribution could relate to microscopic observable but the modification of distribution seems to depend on gravitational field created by solar system so that astrophysical and microscopic dynamics couple at the level of probability distributions. I have proposed a mathematical model involving p-adic numbers and their quantum counterparts as a model for the effect but have not been able to understand this astro-micro correlation. Could it be that Shnoll effect allows to describe also statistical psychokinesis. This would lead to precise number theoretic predictions and the model would be testable.

There is an interesting analogy with quantum computation in TGD framework. Individual bits or bit sequences correspond to outcomes of quantum computations inside CD and their distribution determines the outcome of the computation. Intentional variant Shnoll effect would mean that intentional action can affect this distribution. One could localize this intentional action to a CD containing the CDs defining bits.

It is however far from clear whether this model can be formulated as a modification for the probability for a given value of bit. It might well be that the effect is global rather than local and on the distribution of number of bits with a given value. Indeed, in TGD framework reality is 4-D and the sequence of bits produced by random number generator is what correspond to the event rather than single bit!

2. One can of course consider also a local model. A negentropic entanglement with the macroscopic quantum states of random number generator affecting the environment of system responsible for the random event could be in question and change the situation in such a way that second value of bit becomes more probable. Could the magnetic fields associated with the flux tubes mediating the negentropic entanglement with RNG and interacting with the target make second bit energetically slightly more favored? Could the negentropic entanglement prevent the normal state function reduction producing the random number and produce the random number as ATP is transformed to ADP so that operator would perform some fraction of state function reductions? How it is possible to have an effect with a correct sign without any precise knowledge about the functioning of RG?

#### Telekinesis and electrostatics

In the book "Mind at Large" edited by Tart, Puthoff, and Targ there is an article "An Investigation of Soviet Psychical Research" by Wortz *et al* reporting among other things the research related to the electrostatic aspects of telekinesis. The article mentions the work done by Vasiliev and associates with Nina Kulagina and the work of Adamenko with Alla Vinogradova, another highly gifted person in telekinesis. Kulagina and Vinogradova are said to have been able to move objects of .1 kg along table. Interestingly, according to the article PK able persons tend to be women. Adamenko has tried to understand the phenomenon theoretically and has proposed that the static charges of objects and electrostatic forces generated by the subject might explain the effects.

### Adamenko's work

The objects moved by subject persons were located at a table which was a di-electric cube with of side length of .5 meters in Adamenko's experiments.

1. Vinogradova was able to induce an electric charge in cube and then move objects located at the cube. With biofeedback training also other subjects were able to replicate Vinogradova's feat.
2. To move the object the static friction (friction coefficient between .1 and .3) must be overcome. Adamenko theorizes that there is kind of buoyancy force caused by the flow of air molecules involved and that the electric field somehow induces this force.
3. The reported electric field was 10 kV/cm and corresponds to the voltage at which a di-electric breakdown occurs in a dry air. The reported movement of the air could correspond to a corona wind resulting at strong electric fields.
4. Adamenko assumes that the objects had either static charge or that they were polarizable and developed a dipole moment in the external electric field. The electrostatic interaction with the electric field induced by Vinogradova would have been the cause of the movement.

### TGD based model

TGD based model for phenomena is based on the general mechanism of mind-matter interactions allowed by the many-sheeted space-time concept. There are three questions to be answered: How the table and possibly also object were charged?; How the motion of the object was caused?; How the object was lifted from table to circumvent friction force? *How the table and object were charged?* The charging of the table is certainly crucial for the PK effect. Vinogradova could have emitted "topological lightrays" (MEs), as a matter fact high frequency (microwave) MEs propagating like particles within low frequency (ELF) MEs. Negative energy ELF MEs could have served as correlates for entanglement. Entanglement is however not necessary in this case since conscious telepathy is not involved. Microwave MEs would have induced bridges between the atomic space-time sheets of the object and super-conducting magnetic flux tubes of Earth. The bridges would have made possible ionic and electronic currents between these space-time sheets and led to the charging of the table and possibly of also object. A suitable intentional targeting of MEs would allow to control the charge distributions of the table and object and therefore the pattern of the induced electrostatic fields.

*What could have produced the motion of the object?*

The interaction of the object with the electrostatic field of the table is a possible explanation for the PK effect. The distribution of the charges of the table and object would allow to control the field pattern and thus the direction of the electrostatic force. This is however not the only mechanism. Ionic currents from the magnetic flux tubes to the atomic space-time sheets of the object produce recoil effect (momentum is conserved only in many-sheeted space-time, not for single space-time sheet), and this could have been the fundamental mechanism of motion (essentially the mechanism of rocket motion). In both cases the subject would have produced only the ME bridges taking care of the control of motion but would not have provided the energy and momentum.

The experiments of Modanese and Podkletnov [H5] provide support for the mechanism. Modanese and Podkletnov studied capacitor at a rather low temperature and at a voltage near the di-electric breakdown voltage. The second electrode was a super-conducting disk. The resulting discharge was large and coherent and accompanied by radiation pulses of unknown type. The pulses induced the motion of the air and kicked test penduli. The force was proportional to the mass of the penduli. The effect caused by the pulses did not weaken with distance. This supports the view that the pulses were TGD counterparts of the Tesla's scalar waves realized as pairs of massless extremals with three momenta in different directions [K31] and induced temporary bridges between test penduli and magnetic flux tubes inducing the flow of ions and the recoil effect. The same mechanism should be at work as a microscopic and incoherent version in the case of lifters.

*How to circumvent the friction?: a connection with the physics of lifters*



Lifters exhibit the called Biefeld-Brown effect [K103]. Lifters are asymmetric capacitors consisting typically of a wire electrode and planar electrode, are in a voltage slightly above the voltage causing di-electric breakdown. Lifters move in the direction of the smaller electrode. Also the flow of air from the small electrode to the large one is involved. On basis of the experimentation and guide the findings of Juha Hartikka, I ended up with a simple model of lifters. What would happen is that there is an electric discharge in the form of small plasmoids (discharge sparks would be analogous to ball lightnings), whose emission from the small electrode causes the recoil effect. The emission of the scalar wave pulses could induce the motion of the air by Modanese-Podletnov recoil mechanism. Since the table is charged, there should be a strong electric field also in the narrow space between the object and table. Therefore electronic discharges from the object could occur, and lead to a small scale lifter effect lifting the object slightly above the table. This does not require the object to carry a net charge.

#### **Could the remote EEG sensor of Sergeyev be based on the same mechanism as PK?**

In the same article also the remote EEG sensor invented by the mathematician Sergeyev claimed to remote sense EEG from a distance of 5 meters is described. Unfortunately, the information related to the invention of Sergeyev is classified. What is however known from the existing literature is that the sensor is surprisingly simple, consisting of a metal disk suspended into water and coated with a semiconductor. The immersion in water is reported to double the effectiveness of the sensor. According to the report, the ordinary EEG sensors can detect EEG only up to a distance of few centimeters since the noise of the environment masks the (Maxwellian) EEG at larger distances. Furthermore, the amplifying effect of water is not consistent with the high value of the di-electric constant of water if ordinary Maxwellian electrodynamics is behind the sensor.

Sergeyev's explanation for the functioning of the sensor utilizes bio-plasma hypothesis. The use of the term bio-plasma is remarkable since professional physicists know that plasma state at the temperatures and densities of living matter is not possible in standard physics universe. In TGD framework super-conducting ions leaking from the magnetic flux tubes of the Earth's magnetic field can give rise to what might be called bio-plasma, and Sergeyev's sensor is indeed said to produce bio-plasmagram. Also maser (microwave laser) effect in bio-matter producing ions and electrons flowing into air is mentioned.

All this suggests that EEG MEs containing microwave MEs inducing a leakage of the ions from magnetic flux tubes to the atomic space-time sheets of the metal disk and in this manner generate plasma. The strength of the resulting electric signal would be modulated by the intensity of the net flux of EEG MEs so that information about EEG would indeed result. EEG MEs would not topologically condense at atomic space-time sheets but propagate as bridges connecting the boundaries of the magnetic flux tubes and atomic  $k = 151$  (cell membrane thickness) space-time sheets. This would explain the dissipation free propagation. For positive energy MEs the effective phase velocity would be of the same order as the alpha wave phase velocity since these MEs would tend to "stuck" (in quantum sense). The basic sensing mechanism would be very much the same as explaining the generation of nerve pulse. Also  $Z^0$  MEs could be involved and would usually have a very weak interaction with the environment. The ability of water to act as a many-sheeted maser, presumably crucial for the functioning of living matter, could explain why the water amplifies the effectiveness of the sensor.

Also the remote sensing of the pulsating magnetic fields produced by Nina Kalugina and having strength nearly equal to that of the Earth's magnetic field are mentioned in the article. The possible significance of the pulsating magnetic fields for PK is still poorly understood in the TGD framework: the problem is that solutions of field equations representing this kind of field configurations are not known. One might however think that the pulsating magnetic fields carry also supra-currents, and that their presence intensifies the leakage of charged particles to the atomic space-time sheets of the remote sensor device.

#### **4.4.3 Healing As Rejuvenation?**

The article of Lian Sidorov [J65] and its references give a thorough view about remote healing and viewing. One particular healing method goes under name Qigong [J28]. Qigong is a general term for a large variety of traditional Chinese energy exercises and therapies. Qigong is generally

considered as a self-training method or process through Qi (vital energy) and Yi (consciousness or intention) cultivation to achieve the optimal state of both body and mind. The traditional Chinese medicine postulates the existence of Qi, which could be regarded as a kind of subtle energy circulating around the physical body.

The physiological, chemical and electromagnetic effects of both internal and external Qigong have been studied ([J65] contains large number of related references). Also the effects of Qigong healing on cancer has been studied [J28].

### Negentropic entanglement as Qi?

In TGD framework the energy associated with MEs and supercurrents flowing along magnetic circuitry could be a natural counterpart of Qi. The positive metabolic energy assignable to negentropic entanglement or negentropic entanglement could be an alternative identification for Qi. If entanglement is entropic it corresponds to bound state entanglement and this entanglement of its negative metabolic energy could be seen as the counterpart of “sick Qi”.

Yi could in turn would translate to p-adic cognitive representations representing also intentions, perhaps p-adic variants of MEs or even magnetic mirrors. Internal Qigong refers to self healing whereas external Qigong means directing Qi energy or intention to help others by opening Qi blockages or inducing the sick Qi to get out of body, or helping to achieve Qi balance. The transfer of metabolic energy by ATP-ADP process [?] would be basically a transfer of negentropic entanglement in TGD framework and Qi blockage could be interpreted as a blockage preventing transfer of this entanglement (of metabolic energy in standard framework) would be basically a transfer of negentropic entanglement in TGD framework and Qi blockage could be interpreted as a blockage preventing transfer of this entanglement (of metabolic energy in standard framework).

Zero energy ontology in principle makes possible the creation of matter from vacuum as zero energy states. This process involves a generation of a new CD serving as a correlate for self carrying positive and negative energy parts of the zero energy state at its future and past boundaries. The standard physics interpretation would be as a quantum fluctuation in a space-time volume dictated by CD. At space-time level space-time sheets within CD would be the correlate. Also the transformation of p-adic space-time sheets to real ones and vice versa in the intersection of real and p-adic worlds becomes possible.

### Healing as regeneration of negentropic resources?

De-differentiation of cells taking place in the healing of cancer cells resembles rejuvenation. But what does rejuvenation mean? The first guess is that it corresponds to time reversal and running of biological programs backwards so that the stage before the emergence of disorder is reached. This interpretation is attractive but during the preparation of this article I realized that it does not conform with the most recent view about what the arrow of geometric time is [K6].

To begin with, one must understand how the arrow of psychological time is induced from quantum arrow. This question is not completely understood in TGD framework. There are several arrows of time: quantum arrow of time, arrow of the geometric time of 8-D embedding space, and the arrow of the geometric time of 4-D space-time sheet of subsystem identifiable psychological time.

1. Quantum arrow of time has a nice explanation: for zero energy states either positive or negative energy states (but not both) can be chosen to have well defined single particle quantum numbers - they are prepared. The simplest manner to identify quantum jump and unitary process  $U$  would be as state function reduction taking place alternatively for positive or negative energy part of the state. One would have time-flip flop at embedding space level: the arrow of 8-D embedding space geometric time would alternate. This of course sounds weird unless one makes a sharp distinction between different times.
2. What about the arrow of the time at 4-D space-time level? What is clear that observer of space-time as Flatlander does not observe the change of the arrow of embedding space time but experiences constant arrow of time reflecting itself as second law. In fact, entropy defines natural time coordinate for Flatlander. This can be understood if quantum average 4-D space-time surfaces associated with subsequent zero energy states effectively combine to

form a multiply folded towel like structure. In quantum jump 4-D space-time surface can be said to turn downwards at the upper end of CD, return back to turn upwards at the lower end of CD, and so on. Flatlander would experience the flow of 4-D time as a continual increase of entropy manifesting itself as properties of the space-time sheet with which Flatlander identifies herself. The 4-D arrow of time would not change. Only by observing space-time sheets in different time scales would make possible for the Flatlander to discover that the 8-D embedding space arrow of time alternates. Phase conjugate laser beams and self assembly in biological systems would represent examples of processes allowing to overcome the restrictions of being Flatlander. During last decades we have been indeed able to overcome these restrictions as the discovery of phase conjugate laser beams demonstrates [D5]. In TGD framework massless extremals (MEs, topological light rays) provide a representation for the phase conjugate laser beams. Also the discovery of Italian physicist Fantappie that living systems are characterized by both entropic and syntropic processes demonstrates the presence of both directions for the arrow of time at embedding space level [J64, J16].

In this framework healing corresponds to rejuvenation if the age of cell is as entropy defining also a measure for the amount of differentiation that has occurred. By second law ageing would be reduction of negentropy resources and healing as rejuvenation would mean the increase of negentropy of the system. This is possible if the notion of negentropic entanglement is accepted. The healing as increase of the negentropy of the system implying rejuvenation should take place in state function reductions and NMP [K52] would make them possible if the notion of number theoretic entanglement entropy is accepted.

#### How topological light rays and magnetic flux tubes relate to healing?

Massless extremals are excellent candidates for the space-time correlates of communication and control signals and depending on the sign of the energy can propagate in both time directions. Real bosons correspond to wormhole contacts connecting positive (negative) energy MEs whereas virtual bosons are identified the wormhole contacts connecting positive and negative energy MEs. In zero energy ontology it makes sense to speak about quantum jumps transforming p-adic MEs to real ones and about reflection of MEs in time direction so that positive energy ME transforms to negative energy ME or vice versa. Also MEs analogous to virtual particles are possible. They correspond to pairs of MEs with opposite time orientations so that the wormhole throats carry opposite signs of energy. In this case the classical momentum is not anymore light-like and although wormhole throats are massless the boson itself can be interpreted as a virtual off-mass-shell particle.

In quantum optics time reversal is known as a phase conjugation [D5] and is one of the basic notions of holography. MEs act as both quantum holograms and receiving and sending quantum antennae of [K62]). MEs can generate reference waves of coherent photons interacting with other MEs and activating dynamical holograms of coherent light. If the reference wave is phase conjugated, the resulting hologram is time reversed.

What makes this so interesting is that MEs and magnetic flux tubes are the tools of quantum control in the TGD based view about biosystem as a symbiosis in which MEs control superconducting magnetic flux tubes controlling ordinary matter at atomic space-time sheets via the many-sheeted ionic flow equilibrium. The coherent light pattern emitted by ME resulting from the interaction of ME with the reference wave (its phase conjugate) could act as a control command (time reversed control command) inducing process (time reversed process).

How topological light rays and magnetic flux tubes relate to healing?

1. In the original vision about healing as time reversal for biological programs phase conjugate reference waves would provide a simple and general mechanism of healing by time reversal allowing the living matter to fight against second law. This picture is however inconsistent with the recent view about the arrow of time.
2. In the recent view about the arrow of time topological light rays generate non-local single particle excitations at the flux tubes carrying cyclotron Bose-Einstein condensates and the resulting negentropic entanglement induces healing.

#### 4.4.4 Near Death Experiences

Near death experiences are rather commonly experienced, say by the victims of various accidents. These experiences are known for centuries but it was the best-selling book “Life after Life” of Raymond Moody which brought these experiences known to the general public [J76].

##### 1. *What NDEs are?*

NDEs seem to possess invariantly the same characteristic features. There are feelings of peace and joy, time speeded up, heightened sense, lost awareness of body, seeing bright light, entering another world, encountering a mystical being or deceased relatives and coming to a point of no return. The experiences seem to proceed in quite universal manner. First comes a loud buzzing or ringing noise and a long dark tunnel. Patient sees his own body from outside and does not feel any pain or agony anymore. Patient meets others and a being of light who shows his life in its entirety as a kind of playback to evaluate. Then comes the point of no return, and although patient feels peace, joy, and love, the patient has to return to continue his life. Often these experiences induce very profound changes in the subsequent life of the patient. The claims of Moody have been supported by subsequent research and hardly anyone, even the most foolhardy skeptic, denies the reality of these experiences.

The latest twist in the development emerged when University of Southampton research team announced the result of a one-year study of NDEs of victims of a heart attack supporting the view that consciousness and mind exist after the brain has ceased to function and the body is clinically dead. The resuscitated patients were various times clinically dead, with no pulse, no respiration and fixed dilated pupils. Independent EEG studies have confirmed that brain’s electric activity, and hence brain function (according to standard dogmas of neuro science) ceases in this kind of situation. 11 per cent of patients who survived the heart arrest however recalled emotions and visions during this state. This announcement has created considerable excitement in various consciousness related discussion groups and the question whether some of the basic dogmas of neuroscience are badly wrong has been raised by the neuroscientists themselves.

##### 2. *TGD based view about life after death very concisely*

It is good to summarize the latest TGD based view about consciousness after physical death before comparison with other theories and detailed analysis of NDEs. The view, which is certainly not the only possible one can imagine, is supported by the improved view about psychological time.

The basic notion is that of 4-D body involving both the physical body and the magnetic mirror structures associated with it. 4-D body is gradually carved like an artwork via state function reduction sequences which can correspond to both directions of geometric time in zero energy ontology. Self interprets these sequences for sub-selves as sensory perceptions and motor actions which would be thus time reversals of sensory percepts. This fractal trial-and-error construction of the 4-D body occurs in various time and length scales. Gradually increasingly stable 4-D body results.

Since magnetic mirror structures are fundamental for the field realization of the genetic code, one can quite well consider the possibility that this process induces also the self-organization of the ordinary living matter around the magnetic mirror structures. This would have interpretation as a reincarnation. Buddhas able to resist the temptation to reincarnate would continue their life at the field level. Interestingly, the development of physics from Newtonian physics of the material bodies to Maxwellian physics of fields would mirror the evolution of consciousness from concrete biological life to life at the field level.

##### 3. *Astral plane theories for NDEs*

There are several theories of NDEs. A theory enjoying popularity in New Age circles is based on the notions of the astral projection and next world stating that we have another body that is vehicle of our consciousness which leaves the body at the moment of death. Although completely respectable as such, this kind of theory is not based on existing or even postulated physics, and is therefore hard to test. The notions of “higher vibrational level” and “astral plane” are simply devoid of a physical meaning.

In TGD framework the idea about “vibrational levels” generalizes in an astonishing con-

creteness to an entire hierarchy of electromagnetic life forms and electromagnetic bodies whose sizes vary to astronomical length scales [K37, K77]. In this framework the idea about brain as a seat of consciousness is an illusion resulting from the fact that sensory data is mostly about the immediate region around body. Of course, even the idea that consciousness (as opposed to its information contents) can be localized to some part of space-time, is basically wrong in TGD approach.

A possible test for the astral projection theories is a weighing of the body after death to deduce the weight of the astral body (assuming of course that astral planes obey ordinary physics!). If “astral planes” correspond to the p-adic space-time sheets, this test of course does not make sense. Magnetic mirror structures are obvious candidates for astral body and are real but their separation from body is impossible so that this kind of measurements do not make sense. The notion of 4-D body also suggests that the physical body remain in the geometric past in the physical death wherefrom it can communicate with the living ones via the magnetic mirrors of magnetic body.

Extrasensory perception via astral bodies is a second possible test. This test might make sense if extrasensory perception can be generated by patterns of ELF em fields as supposed in the TGD inspired model of qualia. Magnetic mirrors connecting organisms to each other and also to “nonliving” matter make possible ESPs. Also direct electromagnetic perturbations of the magnetic sensory canvas can give rise to ESPs: in [K47] the possibility that the strange sounds produced by meteors [F3] could correspond to ESPs is discussed.

#### 4. *Tunnel experience*

The theory of Grof and Halifax [J49] is based on the observation that NDE involves elements which might be assigned to the moment of birth. Perhaps NDE is reliving the moment of birth. The counter argument is that the newly born baby does not see anything unless she is able to perceive extrasensorily. “Nothing but hallucinations” theories are of course no explanations at all and belong to the same category as “consciousness as mere illusion” theories. In neuroscience framework also the wake-up reality is seen basically as a hallucination produced by brain and coupled with sensory input to guarantee correspondence with what is out there.

The tunnel is experienced also during epilepsy and migraine, during meditation and relaxed state of mind, and with certain drugs like LSD, philocybin and mescaline. It has been suggested that the physiology of brain could explain the properties of near death experiences [J60]. The theory of Cowan [J60] states that the tunnel results from a failure of the inhibition leading to brain induced activity yielding visual experiences. What is however questionable is why person would feel falling into the tunnel, to say nothing about meeting deceased relatives. Blackmore and Troschienko have proposed a theory in which also the motion along tunnel could be understood as a visual illusion [J25].

TGD based explanation for tunnel experience might be simply as a direct visual experience about magnetic flux tube structures resulting from the perturbation of the magnetic sensory canvas outside body. Thus a genuine ESP would be in question. Magnetic field obeys indeed same basic equation as incompressible liquid flow. Both retinas and pineal gland (“third eye” literally since it contains retinal pigments and serves as a genuine third eye in some species [K37] are magnetic structures. The practically always present vortex in center (“third eye” in my private terminology) could correspond to the magnetic flux tube structure emanating from the pineal gland whereas the very dynamical flow could correspond to the contribution of retinas. If the magnetic mirrors are universal electromagnetic bridges connecting us to other living beings, in particular to our friends and relatives, the meeting of the 4-D bodies of the deceased relatives would happen at the level of fields. The movement along the tunnel could correspond to the propagation along this kind of magnetic mirror.

I cannot resist the temptation of telling about a personal “tunnel experiences” taking place every-daily although this might be criticized as highly unscientific. For me science is attempt to identify the regularities of conscious experience and the only conscious experience I have is my own! As I close my eyes in a half-meditative state achieved by writing at computer terminal, I can see a dim flow consisting of points. Typically this flow enters to or emergences from a tunnel. It can be rotating spiral like flow or simple sink or source. Source or sink can be also linear structure. Earlier this experience was not stable and tends to fade away all the time, and after few minutes I was not anymore able to achieve it. Situation has changed quite recently: I can have the

experience almost anytime in peaceful state of mind. During the “great experiences” this flow was much more complicated and completely visible and formed a stable background of the ordinary visual experience and of hallucinatory visual images.

There is however no experience of entering into the tunnel in this case so that the tunnel need not be the same as encountered in NDEs.

##### 5. OBE aspect

Blackmore explains OBEs [J80] as resulting from the replacement of ordinary self-center experience of world with bird’s eye of view model where brain sees own body from above. Bird’s eye of view is only a memory model so that extrasensory perceptions are predicted to be impossible during OBEs. There is however some evidence that patients can report very precise visual perceptions during OBE. It has been indeed argued, that some other senses than vision, namely [K73] [J80], could create indirectly these perceptions. It is however difficult for even the most hardborn materialist to understand how a clinically dead person could be able to effectively see by hearing, since this feat is impossible for even completely healthy person.

The idea of Blackmore about bird’s eye of view is very attractive as such and can be interpreted in TGD framework in quite different manner. Cognitive maps based on the canonical identification map [K36] typically exterior to inside and vice versa. Thus both a p-adic map of the external world realized inside brain and a p-adic map of body and its surrounding realized outside the body are possible and would give models of the external world and self. The inside-to-exterior map could provide a bird’s eye of view about body and its immediate surroundings.

Both exterior→interior and interior→exterior maps could contribute to the conscious experience even under the normal wake-up consciousness and the exterior contribution would thus represent genuinely extrasensory contribution to the conscious experience. When the ordinary sensory input and volitional activity ceases as during NDE, the contribution of the model of external world to the conscious experience becomes negligible. The ability to experience tunnel unstably during relaxed wake-up consciousness with eyes closed is consistent with the interpretation that these two components are competing. It is quite possible that during sleep the bird’s eye of view component also dominates but that no memories about this period are generated for the simple reason that the brain functions necessary for the generation of the memories are not active.

The notion of magnetic sensory canvas implies that we actually see at ELF frequencies. Same applies to other senses. This implies the possibility of experiences without any sensory input or even without any neuronal activity. The needed ELF MEs acting as sensory projectors would be generated in the dropping of ions from atomic space-time sheets to the magnetic flux tubes of magnetic body carrying field strength.2 Gauss (Earth’s magnetic field has nominal value.5 Gauss). If the ion drops in high  $n$  cyclotron state the subsequent decay of the state by cyclotron transitions generates a bundle of parallel ELF MEs giving rise to the sensory projection. This representation can be generated by the entire body and would give rise to a three-dimensional vision about body as seen by the environment. There is some evidence for this kind of anomalous vision.

1. Yogis have reported altered states of consciousness in which they see their own body three-dimensionally, that is simultaneously from all directions.
2. Becker tells in his book “Cross currents” [J78] about a young cancer patient who told that he can see the interior of his own body. The patient could locate the calcium deposit left as tumor vanished. This supports the view that ELF MEs could project from the entire body to the sensory canvas.
3. Also the OBE experiences, for instance those associated with NDEs, could have a similar interpretation. The sensory input from eyes and even the input from neural activity could be absent during NDEs so that the visual experience should be determined by the background ELF component emanating from the brain and body. The third person perspective associated with OBEs might be always present but be masked by the strong sensory input.

What has been said applies also to other senses. Maybe a personal reminiscence is allowed. I As I was younger I often woke-up partially and realized that I hear my own snoring as an outsider: not a pleasant experience! Sometimes I had an experience which might be interpreted by saying

that the hearing in the first perspective is superposed with the hearing in the third person perspective. The third person hearing has a time lag so that the outcome is a kind of double breathing with time lag.

Sensory canvas hypothesis provides a more concrete view about the situation. The magnetic mirrors connecting brain to sensory canvas should be there also in the absence of sensory input. Could it be that the out of body view is always involved but masked by the from the body view and after the physical death only out of body view remains?

The competition between bird's eye of view and sensory view has also EEG correlate. Delta waves in the EEG spectrum are natural EEG correlates for the external part of cognition. The reason is that this part of EEG frequency spectrum has a shape and intensity very similar to that for the so called sferics [F1], which correspond to meteorological electromagnetic perturbations typically associated with thunder storms. Could sferics be the electromagnetic correlates of discarnates?! The degree of the sensory alertness correlates directly with the ratio of the EEG net intensities in the delta band and in higher EEG bands [F1]. This is consistent with the competition predicted by NMP. Certainly in the NDE experiences studied by the Southampton team only delta band is present in EEG. Note that delta waves dominate also during deep sleep.

Also alpha band is a good candidate for communicating sensory information to higher level selves having magnetic sensory canvas receiving sensory input from several brains simultaneously. It is indeed alpha band in which detectable changes occur in remote vision and remote healing [J65]. Could it be that higher than alpha consciousness somehow transforms to alpha consciousness in physical death and could it be that alpha consciousness relates with the fact the lowest Schumann frequency associated with the perturbations of Earth's magnetic field is in the alpha band? It might be that magnetic transition frequencies are involved with the "vertical" communications from brain to the sensory canvas whereas Schumann resonances would be involved with the lateral communications between different sensory canvases. The fact that hypnagogic experiences involving also identification with other persons (personal experience) appear in the borderline between wake and sleep when dominating EEG frequencies are around 7.8 Hz supports this view.

#### 6. *Life review*

Blackmore explains the life review as an effect analogous to the lively episodal memories generated by stimulating temporal lobes. This explanation leaves open what exactly happens in the stimulation of the temporal lobes and what episodal memories are. To say nothing about the systematic review and evaluation.

In TGD framework brain and perceptive field are four-dimensional and it is quite possible that episodal memories are multitime experiences involving input which comes from the moment of the geometric time when the recalled experience happened and happens again at the level of sensory representation but not as real life event since this would involve macroscopic volition and induce miracle life events in the geometric future. The notion of 4-D body makes this idea concrete. In the physical death 4-D body becomes in some sense mature (about possible de-construction processes in shorter time scales). The volitional contribution essential for the illusion that world is 3-dimensional is not anymore present and entire 4-D body is experienced as a whole. Perhaps this is just what life review is.

Since geometric memories are in question, the review is only a narrative since our geometric past changes all the subjective time and the review is about geometric past subjectively now. Life review would be a temporal counterpart of the OBE experience in the sense that one sees one's geometric life history from outside in a 4-dimensional sense. This is possible since p-adic cognitive representations are four-dimensional and four-dimensional bird's eye of view could begin to dominate at the moment of death.

Also genuine subjective memories about time interval equal to the wake-up period of self and of order lifetime could be in question. This requires the occurrence of what might be called a p-adic phase transition to higher level self with much longer subjective memory: this view is in accordance with the vision about the physical death as a birth to a life in "other world". p-Adic phase transition could mean that the p-adic magnetic mirrors after the geometric time after physical death correspond to higher value of  $p$  and quite concretely, have lengths which are longer than during the physical life. This makes possible both geometric and subjective memories in much longer time scale.

### 7. Positive emotions

With the motivation coming from the OBEs associated with the temporal-lobe epilepsy, it has been suggested that brain-stress near NDE episode leads to the release of neuropeptides and neurotransmitters (in particular endogenous endorphins) which are responsible for positive emotional states like joy, peace, and love. Again the question concerns about the deeper mechanism. Presumably these neurochemicals are only correlates for the experiences in which extra-sensory component of the experience begins to dominate. It has been also suggested that the lack of oxygen is what gives rise to the NDE experiences [J80]. The observations of the Southampton team seem to exclude these explanations. Of course, one could claim that some core parts of brain are working even when the patient is clinically dead (no respiration, no heart beat, dilated pupils) and that these functioning parts of brain are able to generate NDE. If so, spiritual experiences would represent the lowest possible levels of consciousness, and even reptiles would have them: perhaps a vulgar skeptic could applaud here but I do not find this idea very convincing.

In TGD framework clinical death naturally implies that extrasensory component of the conscious experience begins to dominate. This picture is consistent with the view about brain as p-adic–real transformer rather than the seat of the entire conscious experience. The dominance of the positive emotions would simply mean that the negative emotions coming from sensory input would be absent.

### 8. Other worlds

The experiencing of “other worlds” requires a considerable amount of hand weaving in the standard neuroscience framework. Blackmore claims that imagined worlds are experienced as real because these experiences are the most stable. I believe that Blackmore is right in the sense that mental images (sub-selves) correspond to self-organization patterns which are stable asymptotic states of self-organization. I do not however believe that this is an essential point, and certainly Blackmore’s explanation fails if the interpretation of the Southampton team about NDEs is correct.

In TGD framework the other worlds might correspond to the emergence of magnetic mirror structures which correspond to higher value of p-adic prime than during the physical life. They would have much longer lengths and give rise to much longer subjective and geometric memories. Note that the MEs associated with magnetic mirrors are classical representation for light (which brings in mind Tibetan book of death!) so that one could say that the deceased becomes a light being in a well-defined sense. The meeting of the light being might mean an ability to communicate with and sensorily experience the presence of other light beings, natural if the deceased herself has transformed to a light being (but having still 4-D body in the geometric past, this is perhaps why angels have human body!).

Note also that the absence of sensory and corresponding cognitive mental images during NDE is analogous to the empty mind free of mental images which is the goal of the meditation practices. Perhaps soul could be identified as a self having no sub-selves, “irreducible self” as suggested in [K82].

### 9. After effects

The after effects induced by the spatio-temporally extended consciousness in which one sees one’s own life from outside are often dramatic. It is difficult to reduce these after effects to brain pharmacology.

My own “great experience” had many aspects common to NDEs and induced profound (not at all pleasant!) changes in my own life. In my case the direct experience of the higher levels of reality made possible the realization how magnificent the almost-boring everyday reality really is when seen through sharpened senses, how pathetically narrow the zone of wake-up consciousness is, and how ridiculously little the celebrated big science tells about reality. This realization resulted in a strong conviction that I am on a right track, and has given the courage to work these fifteen years as a ridiculed scientific dissident in a country in which vulgar skepticism is in the role of a scientific state religion and vulgar skeptics have taken the role of the mind police of science.

## 4.5 Conscious Hologram And Remote Mental Interactions

The notion of conscious hologram allows also a unified description of remote mental interactions.



### 4.5.1 Big Vision

The notion of conscious hologram, which is based on the generalization of the notion of Feynman diagram, provides a general view about remote mental interactions.

1. Brain can be seen as a part of a gigantic dynamical and fractal brain consisting actually of the entire universe. The same mechanisms that work at the brain level work also at larger length and time scales. Brains/bodies serve as “neurons” for the magnetospheric selves receiving information from several brains/bodies. In particular the fusion of the mental images defined by similar structures can give rise to stereo-consciousness, and the notion of species consciousness and even multi-organ consciousness associated with various kinds of organs makes sense.
2. The notions of super-genome and hyper-genome provide a concrete view about how transpersonal levels of self-hierarchy are realized. Super genes are magnetic flux sheets containing sequences of genes like text lines at the page of book. Hyper genes are flux sheets containing sequences of super-genes belonging to different organisms as genetic text lines. This picture conforms nicely with and generalizes Sheldrake’s species memory and “alike likes alike” rule. It also suggest a concrete realization of remote biological mental interaction based on activation of gene expression and nerve pulse activity.

The flux sheets associated with super-genome and hyper-genome have fields strengths of magnetic field of Earth. The correlation of the quality of remote cognition performance with sidereal time [J59] leads to the hypothesis that also the flux quanta of galactic magnetic field couple somehow to living matter.

3. Besides time mirror mechanism charge entanglement realized in terms of  $W$  MEs is a basic mechanism of remote mental interaction. The simplest model for the generation of nerve pulse is based on quantum jump leading to a state in which Bose-Einstein condensate of  $\text{Ca}^{++}$  and/or  $\text{Mg}^{++}$  becomes exotically ionized and generates charge flow through cell membrane. Quite generally, charge entanglement would be part of the ordinary bio-control realized in terms of  $\text{Ca}^{++}$  waves. Charged entanglement provides also a mechanism for the sharing of mental images between magnetic body and biological body. There is no reason why this mechanism could not work also at the level of other remote mental interactions than those that we are too familiar with to realize that remote mental interactions are in question. The typical time 13-15 seconds associated with the remote realization of intentions by Qigong masters [J47] could correspond to a typical duration of  $W$  entanglement.

The models for bio-photons bio [I20] and Gariaev’s findings [I17] suggest a tentative model for how remote mental interactions proceed. Charged entanglement via  $W$  MEs makes possible sharing of mental images. After a reduction of entanglement the generation of positive and negative energy MEs occurs and involves time mirror mechanism making possible remote metabolism and communications of declarative memories. In the case of ordinary bio-control magnetic body utilizes the metabolic energy resources of biological body.

4. Association mechanism works also for remote mental interactions and is even in the case of brain based on MEs and magnetic flux tubes with neuronal firing and metabolic activities being side products of the this mechanism.
5. One of the strange findings about remote mental interactions is that remote viewer can receive information about an object for which she knows only coordinates, which as such are meaningless numbers to her. It is also commonly reported that erroneous readings or interpretations of the target tend to propagate to other viewers. These findings suggest that magnetospheric (earthly or galactic magnetosphere could be in question) dynamical multi-brained selves act as kind of relay stations mediating the remote contact between remote viewer and object. If some brain knows the meaning of the coordinates of the target, this is enough to connect remote viewer to the correct target.

Empirical support for the notion of multi-brained collective levels of consciousness comes from the experiments of Mark Germaine [J66]. An operator and a subject person were involved. The

stimulation of the subject person consisted of a sequence of identical sounds containing now and then an odd-ball stimulus (now silence). The odd-ball stimulus generated an event related potential (ERP) visible in EEG and reflecting the conscious reaction. The operator was in a second room and by simple toss of coin decided whether to observe the stimuli in the computer monitor or not. The stimuli appeared in the computer monitor one second before they were heard by the subject person.

What was found that when the operator saw the odd ball stimulus from the computer monitor, the ERP was weaker on the average. An 11 Hz periodicity was the major component in the difference profiles.

The simplest explanation is that the brains of both the operator and of the subject person belong to a larger multi-brained self and that the evoked response represented partially the reaction of this self. When this multi-brained self had already seen the stimulus through the operator's eyes, it was not so surprised to hear this stimulus again through the ears of the subject person, and ERP was weaker.

The appearance of the 11 Hz periodicity suggests that this frequency is an important correlate for the entanglement of the subject person's mental images with those of some multi-brained magnetospheric self. The cyclotron frequencies of most bosonic ions in Earth's magnetic field are in alpha band so that the finding is consistent with the vision about a fractal hierarchy of generalized EEGs associated with the dark matter hierarchy [K29]. The notion of hyper-genome provides a detailed model for how transpersonal levels of self hierarchy control the behavior of groups of individuals. The hypothesis could be tested by looking whether the gene expressions of individuals having close personal relationship but not in a direct personal contact correlate.

#### 4.5.2 Sketch For What Could Happen In A Typical Remote Viewing Experiment

Consider a situation in which a system consists of remote viewer A, person B knowing the position of target T and the coordinates XYZ for it. B gives the coordinates XYZ for person C in turn giving them to the remote viewer A. The following simplified sketch assumes that communication channels are permanent and that the intentions involved with the process are realized as p-adic space-time sheets in the brain of A, and very probably involve p-adic MEs as representations of the intentions.

1. Remote viewer A, person B knowing having target-XYZ association as two mental images in his brain, and target T have permanent bridges to a magnetospheric multi-brained self M. Therefore M knows the target-XYZ association via the brain of B.
2. Remote viewer A is a client of the multi-brained self M using the remote sensory services provided by M. A-M contact is more or less permanent: this is what it means to have the ability to remote view. Minimum requirement is the existence of magnetic flux quanta connecting A to M. The sharing of mental images requires generation of entanglement, say charge entanglement by  $W$  MEs. This would correspond the most primitive passive mode of remote viewing.  $W$  mode allows to share also mental images of primitive living systems like plants, and even those assignable to system regarded usually as in-animate. The reduction of charge entanglement makes possible remote mental interaction since resulting charge non-equilibrium generates currents: generation of nerve pulse and  $Ca^{++}$  waves would represent basic example of this kind.
3. One can imagine also active mode of remote viewing and this could be involved with telepathy: in this case M would not be involved. This mode involves intentional action (p-adic MEs are transformed to their real variants) and classical communications with the geometric past/future using neutral negative/positive energy MEs could realize declarative memories/"declarative" precognition as well as motor action based on classical communications using symbolic representations. The model for bio-photons suggests that  $Z^0$  and em MEs are generated after the reduction of charge entanglement. The ability to predict reasonable well the personal future could rely on "declarative" pre-cognition. The evolution from bicameral mind to modern consciousness [K84] could have proceeded from a mere sharing of mental images by  $W$  MEs to complex classical symbolic communications involving also neutral MEs.

4. Since M cannot be assumed to have anything comparable to a nervous system, A-M communications should rely on sharing of mental images. That is, the intention of A (p-adic space-time sheet in brain of A perhaps) to remote view and the questions of A about the target would be shared by M. T-M communications could involve classical communication with light velocity generating magnetospheric sensory representation about the target by self-organization. The 13-17 second delay of remote mental interactions [J47] could correspond to the typical duration of charge entanglement. Target could be also “non-living”: it is quite possible that magnetospheric selves form sensory representations also about “non-living” matter. The finding that meteor sounds have frequency spectrum in the 40 Hz band of thalamocortical resonance frequencies, rather than in the predicted 20-20.000 Hz band, supports the view that magnetospheric sensory representations at 40 Hz resonance band are associated also with the non-living matter [K45], [F3]. Also the vision about dark matter hierarchy conforms with the idea about Earth’s magnetosphere as a living organism.
5. Remote viewing by the sharing of mental images means that there are no sensory receptors associated with the passive mode of remote viewing: no such receptors have been identified [J67]. Various physiological correlates (say EEG patterns) of remote viewing should be reactions to the shared mental image rather than direct correlates of it. If primary sensory qualia are at the level of sensory organs, remote viewing differs from hallucinations in that there is no feedback to the retinas from cortex responsible for “qualiafication”: this could provide be a clear-cut test. At least in the case of living targets the laws that govern the ordinary sensory perception should hold true for the remote viewing. For instance, the known correlation of the AC performance with the spatial and temporal entropy gradients of the target should hold true for living targets. Even in the case of a non-living target similar correlation holds true if the sensory perception of magnetospheric selves obeys same laws as that of ours: there is some evidence for the correlation of the entropy of non-living target with the AC performance [J67].

### 4.5.3 About The Physiological Correlates Of Anomalous Cognition

In the article “Physiological correlates of Psi cognition” of Charles Tart [J29] some apparently contradictory findings about physiological correlates of anomalous cognition are described besides the experimental findings of Tart. Changes in EEG, galvanic skin response, finger pulse, and basal skin resistance are examples of possible candidates for the physiological correlates of remote mental interactions.

The findings are following.

1. The first class of experiments involves two persons: subject and agent. The agent is subjected to various kinds of stimuli inducing emotional response: sudden sounds, painful stimuli as in the experiments of Targ, etc.. Subject person is typically in a sound proof room and tries to remotely cognize when subject person experiences these stimuli. Various candidates for the physiological correlates are measured. The physiological correlates typically express a heightened arousal. For instance, in the experiments of Tart [J29] galvanic skin response occurred more frequently, and EEG became more complex with more beta waves and fewer alpha, theta, and delta waves.
2. In the second kind of experimental arrangement remote viewing or telepathy is involved but the second person, if present at all, is not subject to any stimuli inducing emotional reaction. Now the physiological correlates tend to be characteristic for a relaxed state of mind. The increase of the basal skin resistance is one such correlate.

At first these findings might seem to be contradictory. The paradox disappears if sharing of mental images is in question and if the mental images induce same emotional response in the subject person as in the agent.

The remotely perceived (possibly sub-conscious) stimulus or remote anticipation of the stimulus induces in the subject person an emotional reaction having as a correlate the reduction of skin resistance. In the experiments of Tart [J29] both the real electrical stimulus experienced by the agent and the electrical stimulus guide by the operator to an electrical resistance instead of

the agent, generates the arousal in the subject. This requires that both the operator, agent, and subject belong to the same multi-brained self so that the reaction of the subject can be interpreted as a kind of conditioned reaction of the multi-brained self expressed via the body of the subject.

#### 4.5.4 Local Sidereal Time, Geomagnetic Fluctuations, And Remote Mental Interactions

The article of J. Spottiswoode [J59] discusses two strange findings about remote mental interactions.

1. There is a statistical tendency of the anomalous cognition (AC) performance to concentrate in a 2 hour period around 13.30 of the local sidereal time (ST), which is the time measured using as a reference distant stars and thus running at a slightly different rate than the solar time: the lag is  $\Delta T = 24/365$  hours  $\sim 3.7$  minutes during 24 hours.
2. The anticorrelation between the level of geomagnetic fluctuations and AC performance has also a maximum during 2-hour period around  $\sim 13.30$  ST.

The fact that AC performance is associated with the same sidereal hour suggests the identification of the galactic magnetosphere as a conscious involved with remote cognition. For interstellar and galactic magnetic fields cyclotron time scales correspond to the time scales of human consciousness so that also these magnetic flux quanta could receive sensory input from biosphere and control it.

#### Support for the role of magnetospheric consciousness

The so called ap index measures the intensity of the fluctuations of the Earth's magnetic field. If the magnetosphere is a conscious entity, ap index can be interpreted as a measure for the level of arousal of the magnetospheric mind. The negative correlation between ap and AC performance tells that AC is most probable, when the magnetosphere is in a "calm state of mind". This is natural since only in this kind of situation the noise masks minimally the signals from the galactic magnetosphere.

The local magnetic noise produced by the modern high tech environment is much stronger than the geomagnetic noise but this does not matter. If artificial magnetic fields correspond to  $k_d = 0$  level of the dark matter hierarchy, they have no effect on higher levels of dark matter hierarchy. Note that the hypothesis is  $h_{eff} = nh$ , where  $n$  is product of distinct Fermat primes and power  $2^{k_d}$ .

#### Is there an ELF signal from the special direction masked usually by the geo-magnetic noise?

The obvious question is why the anticorrelation between anomalous cognition effect size and ap index is highest at 13.30 ST? What this finding means that a particular portion of the sky defined by a definite longitude is above the head of a successful anomalous cognizer independently of the time of year. Thus there should be something special in a direction at this longitude.

The simplest explanation for these findings goes as follows.

1. Suppose that there is a higher level conscious entity at the direction 13.30 ST at the galactic magnetic body such that various cyclotron frequencies involved with the communications with this entity correspond to a typical time scale of the anomalous cognition. This conscious entity could have size of galaxy or it could correspond to a flux tube of galactic magnetic body using the cognizer and target as sensory receptors and motor instruments just as our magnetic body might use neurons of our brain or our body parts.
2. Anomalous cognition could involve positive and negative energy signals to this magnetic body and back so that essentially instantaneous AC events would be possible.

3. The information transfer between two kinds of flux tubes is made possible by the topological condensation of the flux tubes of  $B_E$  or its dark variant at those of the galactic magnetic field or its dark variant and would be maximal when both are nearly vertical. Also geomagnetic noise would be transferred via wormhole contacts to the flux tubes of the galactic magnetic field and perturb these communications. Both AC and its anticorrelation with geomagnetic noise would be maximal when the flux tubes of of magnetic fields in question are approximately parallel. Since the flux tubes of  $B_E$  are approximately vertical, this the case when the galactic center is directly above the head. This would explain the special value of sidereal time. One can say that the magnetic flux tubes of the interstellar magnetic field define kind of cosmic umbilic cord which might serve as a correlate for the tunnel experience associated with NDEs.
4. If signals to geometric past and back are involved the time and length scales would measured using  $10^5$  years as unit. The signals themselves would be coded using frequencies characterizing time scales of neural consciousness as kinds of ripples to the very slowly oscillating background signal just as perturbations due to nerve pulses interfere with EEG rhythms. Since remote psychokinesis and anomalous cognition should rely on the same mechanism, the first guess for the time scale involved with these signals is as the time lag of 13 to 17 seconds involved with the remote realization of intentions by Qigong masters [J47]: the interpretation as a typical duration of charge entanglement was already proposed. It would not be surprising if the time scale of entanglement would determine also the scale of cyclotron frequencies. This would mean the importance of the frequencies in the range .06 to .08 Hz for anomalous cognition.

The following scenario suggests a possible manner to understand the time scale of remote PK.

1. If protonic cyclotron transitions generate the low frequency MEs in the range  $f_1 = .06$  Hz to  $f_2 = .1$  Hz, the strength of magnetic field must be in the range 13 to 17 nT (nanotesla). The magnetic flux tubes of an interstellar magnetic field in a direction with a longitude defined by 13.30 ST should be in question.
2. The ends of the magnetic flux quanta attached to structures within the inner magnetosphere co-rotate with Earth. The resulting twisting presumably tends to induce additional noise to the interstellar magnetic field or Earth's magnetic field or both.
3. The strengths of the typical disturbances of Earth's magnetic field are in the range 50-200 nT [J59]. The average strength for a given frequency component for the fluctuating part of the Earth's magnetic field increases at low frequencies. At the alpha band the strength of the Fourier component of fluctuations is about  $\sqrt{B^2(f)} \simeq 1 \text{ pT}/\sqrt{\text{Hz}}$  at alpha frequencies. Interestingly, the magnetic perturbation produced by brain at alpha band has a peak, which is slightly above the fluctuations of the Earth's magnetic field. This is perhaps not an accident in light of the expected role of the alpha band in remote mental interactions. The strength for the Fourier component  $B^2(f)$  for the fluctuations of  $B^2(t)$  [J17] is roughly  $\sqrt{B^2(f)} \simeq .1 \text{ nT}/\sqrt{\text{Hz}}$  at  $f_2 = .01$  Hz, and about  $\sqrt{B^2(f)} \simeq 10 \text{ nT}/\sqrt{\text{Hz}}$  at frequency  $f_1 = .06$  Hz.

What puts bells ringing is that the noise level 50-200 nT is by a factor 4 to 15 higher than the required interstellar static magnetic field at the lower limit corresponding to the 17 second period. These findings suggests that magnetic fluctuations tend to mask the positive effect of the interstellar magnetic field on AC. Only when the strength of the fluctuations of the Earth's magnetic field at the cyclotron frequency of the interstellar magnetic field reduces sufficiently below the strength of the interstellar magnetic field, the masking effect is small enough.

#### What is the origin of the interstellar magnetic field?

The idea about the magnetic umbilic cord connecting distant astrophysical objects to a single quantum coherent whole is sensible in the many-sheeted space-time. The TGD based model for

the galaxy formation assumes that the ordinary matter results from the decay of cosmic strings, which are objects carrying extremely strong magnetic fields (magnetic flux tubes and these objects belong to the same solution family of field equations). These cosmic strings form a complex network. For instance, this model explains gamma ray bursters [K88].

The huge energy production of gamma ray bursters is consistent with their huge distance only if one assumes that the energy is liberated in jets. In TGD framework the gamma ray bursts can be identified as jets resulting in the decay of split cosmic strings giving rise to the ordinary matter. The bursts are indeed known to originate in the regions, where new stars are born. This picture supports the idea about the existence of a fractal magnetic flux tube network connecting different astrophysical objects, and left as a remnant from cosmic strings, when their magnetic energy transformed to the ordinary matter and gave rise to the birth of stars. This network could give rise to galactic nervous systems in turn combining to the central nervous system of the Universe.

Surprisingly, this picture might be consistent with the constraints on the direction and magnitude of the interstellar magnetic field.

1. According to the online lecture of S. Oliver [E9], the measured values of the interstellar magnetic fields depend somewhat on the method with which they are measured (this might be a signal of the many-sheetedness). The interstellar magnetic fields vary in the range  $B_u = 1$  mGauss–  $B_l = .1$   $\mu$ Gauss [E12], which means that both electronic and protonic cyclotron time scales for all interstellar magnetic fields correspond to time scales relevant for human consciousness. The minimal values of  $k_d$  are  $k_d = 53$  for  $B_u$  and  $k_d = 66$  for  $B_l$  from thermal stability: .1 second time scale of alpha band is mapped to 50 s for  $B_u$  and to  $\sim 3$  days for  $B_l$ .
2. The synchrotron radiation associated with the diffuse emission from the whole sky but concentrated towards galactic plane corresponds to a field strength  $\sim .6$  nT. Zeeman splitting for hydrogen 21 cm line from condensing clouds gives fields in 1-2 nT range. In the plane of the galaxy the field is roughly parallel to spiral arms and its strength is 1-1 nT and too weak to correspond to the proposed magnetic umbilic cord. Also the direction of the spiral arm is different from the direction of the required magnetic umbilic cord.
3. The second guess is that the magnetic umbilic cord is orthogonal to the galactic plane. The direction of the galactic North Pole has the right ascension (identifiable as the sidereal time at the meridian of the rotating observer) RA=12.49  $\delta = 27.4$  degrees: RA is not too far from 13.30 so that this guess might make sense. Taking into account that the rotation axis of is tilted by 23.5 degrees towards Sun this would mean that the direction of the magnetic umbilic cord is with accuracy of 3 degrees in the plane defined by the orbit of Earth around Sun. Interestingly, the magnetic field associated with the solar wind varies in the range .2 – 80 nT and average value is 6 nT.

According to [E12], galactic center carries a dipole like field with a strength of order 100 nT, not too far from 10-30 nT. Also this field has filament like structures (flux tubes), which might extend to long distances [E12]. The flux tubes of this field should intersect the galactic plane orthogonally. If the strength of the magnetic field inside the flux tubes stays constant rather than varying like dipole field strength, these flux tubes could give rise to the magnetic umbilic cords connecting us directly to the center of the galaxy. Galactic center, perhaps the immense black-hole region there, could be an monstrous brain having galaxy sized central nervous system! That the model for magnetospheric consciousness would generalize to the scale of entire galaxy would conform with the fractality of consciousness.

4. According to [E12], supernova remnants are accompanied by radial filament like structures carrying magnetic field in 1-10 nT and it seems that supernova wind might carry this field around galaxy: very natural if flux tubes carry the field. According to [E9], for individual sources such as supernova remnants like Cas A Minor, the field strength is 10-30 nT. This corresponds to the interval 5.6 to 17 seconds. That the field strength is of the same order of magnitude as the dipole field at the galactic center conforms with the idea about magnetic nervous system of galaxy connecting the center of the galaxy to the stars. This magnetic

field would be easy to observe in case of supernovae because super nova explosion has packed magnetic flux tubes to a very dense bundle.

### Connections with other effects?

There might be fascinating connections with other strange findings.

1. In Comorosan effect [K112] , [I40] the irradiation of a bio-matter with a laser irradiation lasting for a multiple of 5 seconds has anomalous effect on a catalyst action. 5 seconds corresponds to  $n = 3$  cyclotron transition for proton in a magnetic field of 10 nT. Comorosan effect occurs also in a non-living matter and suggests that the magnetic umbilic cord serves as a kind of cosmic clock.
2. The strength of the Earth's magnetic field in far-away in the plasma sheet is about 10 nT. Could this cosmic magnetic umbilic cord be connected with the plasma sheet and be in a synchrony with what happens there? Plasma sheet is known to be highly self-organizing structure containing in the velocity distributions of charged particles features like "wings" and "eyes" [F2]. In [K47] I have proposed that plasma sheet defines the "self model" of magnetospheric brain and is thus in a role analogous to the insula in the human brain. It would rather natural for the cosmic umbilic cord to couple with that part of the magnetospheric brain which corresponds to the highest level in the self hierarchy associated with the magnetic Mother Gaia.
3. Lungs contain magnetic particles giving rise to magnetic field of about 10 nT. The theory of magnetospheric sensory representations inspires the speculation that the moment of physical death is decided by magnetospheric self sending to lungs stopping signal at proton's cyclotron frequency associated with 10 nT magnetic field.

### 4.5.5 Could Magnetic Flux Tubes Make Possible Effective Holograms?

What conscious holograms really are? Are they genuine holograms or are they holograms only in the sense that the scattering of light beams from them is very much like scattering on ordinary holograms - that is like scattering from the original object. Could one imagine mechanism making possible scattering from the original object effectively represented by the hologram like structure?

To proceed notice that there is rather general belief that just some objects possessed by the patient is enough for healer- in some sense this object are holograms of the patient. Usually this belief is of course regarded as primitive pars pro toto magic. This belief might however have some justification in terms of negentropic entanglement expected to be fundamental aspect of remote mental interactions. In principle negentropic quantum entanglement can take place via arbitrary number of relay stations and magnetic flux tubes connecting the entangled objects would be the quantum correlate for it. Negentropic entanglement would serve as a correlate for attention, experience of understanding, etc., and it would correlate closely with metabolism: generation of ATP and associated high energy phosphate bond would generate negentropically entangled electron Cooper pair or add electron to negentropically entangled existing many-electron system and its decay to ADP would liberate metabolic energy quantum and destroy the negentropic entanglement.

Negentropic entanglement could actually mean that objects of the external world - say living beings - can act like parts of our biological body. There is a wide variety of psychological experiments which show how illusory is our view about what our body is. Quantum entanglement of object with its target having magnetic flux tubes as geometric correlates making object a relay station. The object - call it  $O$  - would only serve as a relay station connected to say person, call it  $P$ , possesses the object. The light scattering from the  $O$  could actually transform to dark photons and travel along flux tubes to  $P$ , where it is scattered back- say from DNA- and returns back along flux tubes and leaves  $O$ . Effectively this is like scattering from a hologram of  $P$  represented by object  $O$ . The flux tube connection would make various objects in our vicinity effective holograms. This is something that one actually expects since attention- both visual and auditory - has flux tubes connecting perceiver to the target of attention as correlates.

One can consider two options since the radiation to object could transform to positive or negative energy photons. In the first case scattering could be seen as ordinary scattering from

*P*. Negative energy photons would however represent signals traveling to the geometric past (analogs of phase conjugate laser beams) and scatter back from *P* as positive energy photons traveling to *O*. TGD based models of memory as communications with the geometric past and intentional action as a process in which negative energy signal to geometric past initiates neural activities (Libet's findings about active aspects of consciousness) involve similar mechanism. Also the remote metabolism based on sending of negative energy signals to a energy storage (analogous to population inverted laser) relies on the same mechanism.

Peter Gariaev's experiments irradiating DNA with red laser beam generate broad of radio waves, which in TGD Universe could correspond to photons with same energy but with large Planck constant. These photons have biological effects on organisms of the same species and even on closely related species. TGD based proposal is that the scattered laser beam defines a collection of frequencies serving as addresses for parts of DNA activating gene expression.

If this represents a basic mechanism of genetic expression, one can quite well imagine that an organism- call it A - whose DNA is somehow damaged, could utilize the healthy DNA of another organism - call it B - by sending to it the counterpart of laser beam which scatters and generates the superposition of dark photon beams serving as an address activating the DNA of A. A would effectively use the DNA of B and B would effectively become part of A: s biological body. This mechanism could explain why the mere presence of healthy organisms of the species can induce the healing of organism which is not healthy. It could be the basic mechanism of healing: patient could remotely use the healthy DNA of the healer to generate signals activating her own genes.

Some further comments and questions are in order.

1. The relay station mechanism could universal in biology. The transformation of ordinary photons to dark photons at flux tubes defining the magnetic body of DNA is assumed in the model explaining the photos taken by Peter Gariaev and his group about DNA sample showing the presence of what looks like macroscopic flux tube structures [K1].
2. The mechanism could also explain phantom DNA as real DNA connected by flux tubes to the chamber that contained the original DNA. The laser beam arriving to the empty chamber would travel along flux tubes to the place, where the removed DNA is, scatter and return back. This would create the scattering pattern assigned with the phantom DNA.
3. One can even ask whether the basic mechanism of homeopathy relies on relay station mechanism. Homeopathically treated water would be a collection of flux tube connections to the molecules, which were present in the first stage of the preparation process of the homeopathic remedy. Since the dark photons travel with light velocity, the times for travel of photons would be so small that the scattering of incoming light via the relay station mechanism would almost instantaneous so that the original molecules would be effectively present.
4. For instance, the de-differentiation of cells which looks to my rather mysterious phenomenon, means rejuvenation. Could one imagine that the genetic programs are replaced with those in geometric past and similar mechanism is at work. Could the rejuvenation mechanism involve scattering of the counterpart of phase conjugate laser light from non-differentiated healthy cells of the geometric past? If so, one should try to achieve the same effect directly at the level of cells. One could try to induce de-differentiation of the cells of the owner of the object serving as a relay station in the same manner. Healing of say cancer cells by de-differentiating them to omnipotent state. In the experiments involving Becker's DC current just this happened. In this microscopic situation might be can demonstrate the effect really convincingly.

#### 4.5.6 Two Attempts To Understand PK

In quantum theory context one can try to explain retro PK (psychokinesis) and perhaps even PK using quantum measurement theory. It seems however that quantum theory is not enough and feedback loop to past allowing to observer to affect the quantum system generating random number. In TGD framework intentional action based on negative energy signal to geometric past would be a rough manner to state what this feedback to geometric past is. For instance, intentional generation of motor action would involve a negative energy signal - say in EEG frequency range -



from the “personal” magnetic body to the brain of geometric past, where it would initiate neural activity leading to motor action.

My attempt to concretize this picture in TGD framework - inspired by an unpublished article by Brian Millar relying on the observational theory of PK first proposed by Walker [J34, J35] (for an earlier article discussing his vision see [J20] ) - led to following two options restricting the consideration on PK in which operator tries to increase or decrease the number of 1: s or 0: s in a random sequence of bits generated by transitions of microscopic quantum system to two alternative final states labelled by bit.

1. For the first option observer (operator of experimenter) performs state function reduction for the quantum superpositions of two states resulting in quantal microscopic process and entangled with bits in data file: one can say that before the reading of the file it contains qubits. This requires further entanglement with observer’s quantum states.

Standard quantum measurement theory alone does not suggest any PK effect since the entanglement with observer does not affect the probabilities of the outcomes of microscopic quantum process. To achieve a non-trivial effect the measurement interaction generating entanglement with the observer must be able to modify the probabilities of the outcomes. This interaction could be called feedback loop in time. This picture seems to me more or less equivalent with that of Brian Millar.

“Too-good-to be-true” option would be that the observer’s intent transferred backwards in geometric time (feedback loop using the terminology of Brian Millar) can affect directly also the bits in data file so that they become superpositions of the originally quantum measured (read) bit, and then perform the quantum measurement as above. In this case PK effect could be observed directly by comparing the file subject to PK with its unaffected copy. The size of the effect would be characterized by the induced mixing. Of course, this kind of idea would have looked completely crazy for few years ago and perhaps even now.

The fact however is that quantum entanglement and quantum superposition have been now demonstrated for increasingly larger systems. Of course, the observer-bit interaction might be extremely weak due to the large energy needed to change the direction of bit classically.

I am a dilettante as a parapsychologist and in order to compare the two options in more detail I have used as background the article “Correlations of Random Binary Sequences with Pre-States Operator Intention: A Review of a 12-Year Program” (see <http://tinyurl.com/oyjvjbw>) [J39] tells about experiments of Jahn and others in which operator tried to affect the RNG output by intentional action: single cycle consisting of an attempt to increase the number of 1s, an attempt to decrease it, and no intention to either direction. Retro PK experiments have been also done: see the articles “PK Effect on Pre-Recorded Targets” (see <http://tinyurl.com/ya92afub>) [J50] and “Addition effect for PK on pre-recorded targets” (see <http://tinyurl.com/yau3ruul>) [J51] of Schmidt. In these experiments the background philosophy seems to be conform with the first option.

There is also a report (see <http://tinyurl.com/owrfo1q>) [J33] about an experiment in which chicken was labelled to a robot preprogrammed for months ago to wander randomly around the room: the path of robot was claimed to change so that it stayed near the chicken. Also Libet’s experiments [J19] support propagation of intent backwards in geometric time in time scale of about.1 seconds.

In the sequel I will consider the quantum measurement theory option and the “too-good-to-be-true” option in more detail. I will also discuss a possible mechanism for intentional action changing the direction of bit represented as a magnetized region.

### Quantum measurement theory option

PK selects the outcome of a quantal microscopic process such as radioactive decay producing a superposition of two states (mapped to superposition of bits by entanglement - qubit in fact) and later to bit by state function reduction. Data file can be said to contain quantum superpositions of bits corresponding to the two outcomes of quantum process and observer (experimenter or operator in PK experiment) entangled with these state pairs in PK experiment and observes/state function reduces the state with click telling whether the outcome was desired.

This stage should bring in the effect of intention and change the probabilities for the outcomes. Standard quantum measurement theory does not allow this: experimenter acts as a passive selector of the outcome. Therefore some kind of feedback interaction propagating to geometric past and affecting the probabilities of outcomes in quantum superposition is needed.

If the data are read before experiment state function reduction takes place qubits become bits. One can also copy the file to a second one and check that the two files are identical. In this case standard measurement theory tells that the effect of observer cannot change the situation and null effect is obtained. This can be of course tested experimentally. Maybe this have been done.

If this option explains the experiment with chicken and robot, the reading of the random number sequence determining the path of the robot before the experiment implies that the labeling of the chicken to robot would have no effect on robot. The interpretation of Libet's findings about neural activity beginning before conscious decision could be that quantum superposition of neural states corresponding to "I do it" and "I don't do it" is generated a fraction of second before the conscious decision which selects either of these options. Does the intentional action propagating to geometric past generate this superposition? Conscious decision "I shall do this or that" would followed by the choice between "this" and "that".

### "Too-good-to-be-true" option

Suppose that the data file is copied and second copy is read by human observer to guarantee state function reduction (according to the standard quantum measurement theory: in TGD framework state function reduction does not require human observer).

In this case the feedback loop of the observer (operator or experimenter) realized as negative energy signals to geometric past must be able to modify the states of the binary digits directly and induce a superposition of binary digits presumably containing a very small contribution of opposite binary digit for a given original digit. After this state function could take place just as in the experiment above. Now the test would be direct: compare the data file with its copy not subject to the action of observer. Statistical procedures would not be necessary and direct demonstration of PK would become possible.

In chicken and robot experiment the chicken could affect the path or robot even if it the file or its copy have been read by human observer. In Libet's experiment decision "I do it" would first generate quantum superposition of options "I do it" and "I don't do it" ("Should I do it?") and select "I do it".

I do not know whether this option even deserves to be killed. Certainly this should be very easy.

### How the intention to increase/decrease the number of 1: s or 0: s could be realized?

Can one imagine in TGD framework any mechanism allowing to increase the number of 1: s or 0: s? The basic vision is following.

1. One can consider magnetic fields or their wormhole counterparts accompanying necessarily elementary particles. Ordinary magnetic fields would correspond to single sheeted magnetic flux tubes carrying conserved magnetic flux. Wormhole magnetic fields consist of a pair of flux tubes carrying opposite monopole fluxes at different space-time sheets and have wormhole contacts at their ends transferring the monopole flux between the sheets. Flux tubes or pairs wormhole magnetic flux tubes play a key role in TGD inspired quantum biology and proposed also to be a basic space-time correlate of intentional action. In the recent case flux tubes would connect the observer (operator or experimenter) to the device storing the bits. For wormhole flux tubes the flux tubes at the two sheets could have  $M^4$  projections, which do not overlap at all so that bits could interact with either flux tube but not with both simultaneously.
2. If bits are realized as magnetized regions, the magnetic interaction between bits and the magnetic field carried by flux tube (or either of the opposite fluxes associated with the wormhole magnetic field) is a natural candidate for the interaction defining quantization axis of spin, and also for the interaction inducing a small mixing of the bits by Larmor precession induced by a small perturbation of the flux tube magnetic field. This perturbation

could be the TGD counterpart of Alfvén wave (see <http://tinyurl.com/nfqj2ng>) inducing geometrical oscillation of the flux tube and therefore the direction of the magnetic field. State function reduction after the perturbation has ceased would produce either value of the bit. The strength and duration of perturbation determines how large the probability of bit reversal is.

If one assumes that magnetic interaction is in question, the most natural choice for the representation of bit is as magnetized region of data tape with direction of magnetization determining the value of the bit. This restriction can be criticized but will be made in the following.

1. The energy needed to turn the bit must be above thermal energy but the minimization of energy costs requires that this energy is not much above it and is therefore larger than  $5 \times 10^{-2}$  eV which by the way is also the order of magnitude for the energy gained by elementary charge in the electric field of cell membrane. This energy is considerably smaller than metabolic energy quantum with nominal value of .5 eV. Therefore metabolic energy of observer could provide the energy needed to turn the bit. Note that p-adic length scale hypothesis strongly suggests a hierarchy of metabolic energy quanta coming as octaves.
2. Classically the effect of the small perturbation of the external magnetic field on spin is Larmor precession (see <http://tinyurl.com/bvxnz8q>) [D2] due to the torque  $\tau = -\mu \times B$ . A simple model is obtained by assuming that the magnetic moments in magnetized region is simply the sum of elementary magnetic moments of (say) electrons, which in magnetized state are parallel:  $\mu = N_e \mu_e$ , where  $N_e$  is the number of electrons in the magnetized region defining the bit. The mutual interaction of spins forces them to have same direction so that they are not free.

Classical torque is time derivative of angular momentum and one has total angular momentum  $J = (Nm/ge)\mu_e$ , where  $g$  is so called g-factor not too far from unity. This gives  $dm\mu_e/dt = \mu_e \times B$ ,  $mu_e = (ge/m)s$ , where  $s$  is the spin of the electron. The situation reduces to single electron level and the oscillation of the magnetized regions takes place with the Larmor frequency  $\omega = egB/2m$  of electron.

This model is of course highly oversimplified but gives a good idea about what happens. The Larmor frequency of electron is given by  $\omega = egB/2m$  and in the “endogenous” magnetic field of .2 Gauss proposed to explain [K74] the effects of ELF em fields on vertebrate brain [J27] ( $2/5$  of the nominal value of the Earth’s magnetic field) is  $f = 6 \times 10^5$  Hz. One expects that the flux tube magnetic fields and their perturbations are considerably weaker so that the perturbation gives rise to a rather slow change in the direction of the magnetic moment classically.

At quantum level the evolution of the magnetic moment reduces to a unitary evolution of electron’s spin by standard Hamiltonian defined by magnetic interaction energy  $E = -\mu \cdot B$  and if perturbation acts only a finite time the final state contains a small contribution from opposite value of spin.

3. If all magnetized regions representing bits interact simultaneously with flux tube, the net effect to the spin/ bit average is zero since the probabilities for the inversion of magnetic moment are same for the values of bit. Therefore it is not possible to realize the intention to increase or reduce the total number of 1s/0s in this manner.
4. Wormhole magnetic fields provide a possible solution to the problem. If the  $M^4$  projections of the two flux tubes involved do not overlap energy minimization favors the attachment of the magnetized region with the flux tube for which the energy  $E = -\mu \cdot B$  is smaller - that is negative. Since the fields of flux tubes are in roughly opposite directions, bits 1 and 0 tend to condense at different flux tubes. Hence a small short lasting perturbation associated with either flux tube can only reduce the number of 1s or 0s but not both and it would be possible to realize the intention “reduce the total number of 1: s or 0: s” equivalent with the intention “increase the total number 0: s or 1: s”. This if the observer’s intention boils down to a selection of the wormhole flux tube carrying the perturbation so that wormhole flux tubes would represent bits at the fundamental level.

The consideration of the energetics for the flip of the magnetization direction brings in naturally the hierarchy of effective Planck constants  $\hbar_{eff} = n\hbar$  (see <http://tinyurl.com/y7c8e6x8>) suggested by the vacuum degeneracy of Kähler action [K33] [L13].

1. For ferromagnets the Weiss mean field theory predicts that in absence of external magnetic field both magnetization directions have same energy. External magnetic field splits the degeneracy. One could say that if one regards the magnetized region as big spin, both spin directions have same energy and external field - now emerging from the observer as flux tubes - removes the degeneracy and defines direction for the quantization of spin. The mean field theory of Weiss (see <http://tinyurl.com/yddtp6gh>) [D3] based on the expression of free energy as function of magnetization as  $F = aM^2 + bM^4 - HM$  is minimized and gives  $M$  as function of  $H = B/\mu$  representing the external magnetic field. For  $H = 0$  one obtains remanent magnetization and clearly both signs of remanent magnetization correspond to the same free energy. This theory is of course thermodynamical theory and it is not clear whether it applies to the recent situation (zero energy ontology quantum theory at least formally a “square root” of thermodynamics).
2. The energy needed to turn the spin of single free electron (for ferromagnet electrons have strong exchange interaction and are not free) must be above thermal energy but the minimization of energy costs requires that this energy is not much above it and is therefore larger than  $5 \times 10^{-2}$  eV, which by the way is also the order of magnitude for the energy gained by elementary charge in the electric field of cell membrane. For electron Curie temperature is 843 K, which corresponds to thermal energy  $E \sim 6 \times 10^{-2}$  eV. This energy is considerably smaller than metabolic energy quantum with nominal value of .5 eV. Therefore metabolic energy of observer could provide the energy needed to turn the spin direction of single electron (note that there is a strong exchange interaction with other electrons). p-Adic length scale hypothesis allows to consider a hierarchy of metabolic energy quanta coming as octaves.
3. Suppose that magnetized region behaves like single big spin so that the magnetic field of flux tube manages to change the directions of all spins simultaneously so that the contribution of exchange interactions is not affected and the change in the energy of the system in external field is due the change of single electron energies only. The large value for the number  $N_e$  of electrons gives for the total energy needed to turn the bit  $E_{tot} = N_e g e B / m$ . For micrometer sized region  $N_e$  is of order  $N_e = 10^{12}$  for one conduction electron per atom. The magnetic field associated with the flux tube is expected to be much weaker than the remanent magnetization of order 1 Tesla. For  $B = 1$  nT one would have  $E_{tot} = .3$  eV, which is of the order of metabolic energy quantum. The electronic cyclotron frequency is in this field 30 Hz and in EEG range.
4. Magnetic flux tubes are identified as carriers of dark matter and dark photons. This suggests that dark photons representing metabolic energy quanta are involved with the effective value of Planck constant  $\hbar_{eff} = N_e \hbar$  (for TGD based view about dark matter see [K33] and [L13]), and that the transition can be regarded as an absorption of single dark photon turning the entire magnetized region. In terms of singular covering of the embedding space, dark photon can be regarded as a pile of sheets of covering of space-time sheet each containing single ordinary photon. These photon space-time sheets should be somehow attached to the electrons of the magnetized region.
5. The attempt to imagine how multi-sheeted photon/magnetic flux tube interacts with the conduction electrons responsible for ferromagnetism, forces to ask whether also they are dark with the same value of effective Planck constant and reside at various sheets of the singular covering having the size of the magnetized region. Only the first sheet associated with the double sheeted structure describing electron would multi-furcate and second sheet would carry external magnetic field, and perhaps also the TGD counterpart of the Weiss mean field interpreted as effective description of quantum mechanical exchange forces and having order of magnitude of 100 Tesla. Weiss mean field could allow an identification as return flux of the magnetic field generated by the multi-sheeted electron state. If so, the multi-furcations of space-time sheets predicted by the vacuum degeneracy of Kähler action

and predicting hierarchy of effective Planck constants comings multiples of  $\hbar$ , would play a crucial role in the condensed matter physics. Also the TGD inspired model of fractional quantum Hall effect [K67] ) encourages to consider this possibility seriously.

The signature for the many-electron states associated with multi-sheeted covering is a sharp peak in the density of states due to the presence of new degrees of freedom. In ferromagnets this kind of sharp peak is indeed observed at Fermi energy (see <http://tinyurl.com/yddtp6gh>) [D3]. Sheets of multi-sheeted covering could also carry Cooper pairs and this could give rise to effective Bose-Einstein statistics of Cooper pairs. In TGD photons emerge from fermions as wormhole contacts with throats carrying fermion and anti-fermion. This raises the question about realizability of Bose-Einstein statistics in Bose-Einstein condensation. If Bose-Einstein condensate corresponds to multi-furcation of space-time sheet, one obtains Bose-Einstein statistics effectively.

As such this model says nothing specific about the temporal direction of the intentional action although it is clear that the situation is four-dimensional in accordance with basic assumptions of TGD inspired theory of consciousness and with zero energy ontology. Most naturally, the negative energy signal to the geometric past could induce a magnetic perturbation propagating along either flux tube.

### Summary

Both models are consistent with the general vision discussed by Brian Millar and thus leave open the question whether it is experimenter or operator, who is responsible the PK effect. Experimenters are not completely objective robots, and successful experimenters could have a dream about demonstrating PK convincingly whereas the operators are chosen in “Big Pot” approach randomly. Sceptic experimenters trying to replicate the experiment would tend to produce null result. Experimenters could prove PK by producing it themselves (not my original suggestion)! Taking this seriously, one faces the question whether similar situation could prevail also in other experiments than those of parapsychology.

## 4.6 TGD Inspired Model For OBEs

It is good to develop the model for OBEs by first summarizing what OBEs are and then listing the basic TGD specific ingredients of the model and then proceed by making questions (I hope that reader does not feel them to be leading).

### 4.6.1 OBEs, Autoscopy, Heautoscopy, And Other Strange Experiences

#### Phenomenological characterization

The phenomenological characterization of OBEs [J9] has been discussed in [J89]. A precise definition of OBE is to have sensation of being outside the body. Autoscopy experience involves a also a sensation of seeing a mirror double of the body or part of it or at least experiencing its presence. There is a form of AS in which some internal organs are perceived. In one form of AS only the presence of double is experienced. AS experiences are often accompanied by physical difficulties such as migraine episodes and epilepsy.

Heautoscopy refers to an experience of meeting one’s alter ego, doppelganger. The main differences to AS is that in AS the double is mirror image and that alter ego is experienced to have also duplicated features of psychological self.

OBEs are classified to parasomatic and asomatic experiences according to whether the person experiences of having body or not. In aparasomatic experience a detachment from both the physical and parasomatic body is experienced. Blackmore suggest that OBE starts when sensory input from the body ceases while person remains conscious [J79] . This brings in mind the notion of subtle body of spiritual practices identified as the body experienced during lucid dreaming [J62]. The notions of guardian angle and ba-ka double of ancient Egypt, could relate to the double body too.

There is also a classification of OBEs to asensory, naturalistic and supernaturalistic ones. Asensory experience lacks sensory percepts about environment, naturalistic one involves perception

of familiar surroundings, and supernaturalistic other-worldly realms like heaven or visits to other planets and contacts with aliens.

One can distinguish between natural and enforced OBEs. Natural OBEs are triggered by exhaustion, illness, traumatic events, NDEs, meditation, etc.. Enforced experiences can result from intoxication, anesthesia, hypnosis, etc..

### OBEs induced by electric stimulation

Relatively recently OBEs and AS experiences have been produced by an electric stimulation of the angular gyrus [J37]. Angular gyrus is located in the parietal lobe, near the superior edge of the temporal lobe, and is involved in processes related to verbal communication and cognition and also with the transformation of written language to internal monologue. The experience developed to a full fledged OBE as the intensity of electric stimulation was increased. The electric stimulation induced responses in vestibular and sensory-motor systems, two of three systems which govern body balance.

According to experimenters, OBE and AS frequently involves what they call pathological sensations of position, movement and perceived completeness of one's own body. These include vestibular sensations such as floating, flying, elevation and rotation, visual body-part illusions (illusory shortening, transformation or movement of an extremity) and the experiences of seeing one's body only partially during OBE or AS. Authors believe that these experiments yield neurological evidence about the common neurological mechanism behind OBEs and AS experiences.

[J89] [J10] has criticized the interpretation of experiments.

1. Only single subject person was studied. She suffered from temporal lobe epilepsy and the epileptic region was at distance of about 2 cm from angular gyrus. Hence one can ask whether genuine OBEs were in question and whether the results generalize to healthy persons.
2. The OBE was not typical. For instance, body was seen only partially and the conscious attempt of the subject person to examine it more closely led to its disappearance. The environment was not perceived.
3. The claimed localization of the spot inducing OBEs to angular gyrus might be an illusion. Same researchers have represented results in which the OBE is induced in a different manner. Interestingly, the experience is associated with the generation of 4 Hz theta wave, which corresponds to the dominating EEG band during sleep.
4. The reductionistic conclusion that OBEs can be reduced to neuropathology and are thus "only" hallucinations is not justified. What has been shown is that electric stimulation of angular gyrus helps to induce the OBE and this leaves a lot of room for theorizing.

### Explanations of OBEs and related experiences

The explanations for OBEs can be divided to two classes.

1. Something is assumed to leave the body.  
This something could be something physical or non-physical ("astral" ). In some cases people who have had OBE share reported of having perceived objects that were actually there and having experienced events and dialogue that truly happened. Charles Tart has documented the case of Miss Z [J30] who in controlled experiments was able to deliver the randomly selected five digit number which was in a position which could be seen only from the position out of her body. Telepathy would be an alternative explanation for this.
2. Nothing leaves the body.  
Parapsychological explanations involve remote sensing and hallucinations. Psychological explanations regard OBEs as basically hallucinations. The observation that electrical stimulation generates both AS and OBE could be seen as a support for this interpretation. Of course, one can ask what hallucinations really are. Furthermore, the reports about seeing internal organs during AS experience [J78] are not easily explainable as hallucinations.

TGD based model does not fit into either category. The model involves the notion of magnetic body serving as the third person receiving visual stimulus from the body and reflecting it back to the brain where it is processed. In this model the conflict between hallucinatory character of AS and OBEs and a real perception of body from outside is only apparent. The basic mechanism allows to develop also a more detailed model for dreams, hallucinations, third person aspect of wake-up consciousness, and directed attention.

### 4.6.2 Questions

In the following the model is developed by posing questions about OBEs.

#### **Where the information processing giving meaning to what is seen is carried out?**

Seeing is much more than just receiving the photons on retina, since a lot of information processing is needed to give meaning to what is seen. This essentially involves a decomposition of visual input to recognized objects having relations to each other and to the past of perceiver. This applies also to the visual percepts during OBEs. The most natural candidate for the system processing the visual stimulus and giving it meaning is the brain of the subject person.

Sharing of mental images allows to consider an alternative interpretation based on telepathy. The sensory organs in other bodies receive the visual stimulus and other brains do the information processing. For instance, “unconscious” victim of accident could share the fused mental images of people around the place of accident. This would explain the case of Miss Z studied by Tart [J30] as telepathy.

#### **Are OBEs “only” hallucinations?**

In TGD framework the first possibility is that the sensory stimulus is always artificial and comes from brain to eyes and other sensory organs by back projection. OBE would be a dream like cognitive representation, simulation rather than a real percept. REM is expected to always accompany OBEs in this case.

There is an objection against this idea. If person is unconscious or has NDE, it is questionable whether she is able to construct such high level cognitive representation as the representation of the state of her own body as seen by outsider is, and even transform it to a sensory representation. One can also ask what hallucinations really are. In TGD framework hallucinations must be generated by an artificial sensory stimulus so that hallucinations and genuine OBEs might involve the same basic mechanism.

#### **Does OBE originate from an actual sensory stimulus?**

The well-known fact that body parts indeed contain holograms about other body parts [I42] (see the discussion in [K40]) and the TGD view about the relationship between dark and living matter [K28] allows to consider seriously the possibility that OBE originates from an actual sensory stimulus.

The dark photon laser beams emanating from the body would be received by a magnetic body containing dark matter at some level in the hierarchy of magnetic bodies and would be reflected back to the receiving sensory organs along MEs possibly parallel to magnetic flux tubes rather than space-time sheets along which ordinary visual input arrives.

It is quite possible that several magnetic bodies in the hierarchy are involved. The magnetic bodies involved need not always correspond to a personal magnetic body and could receive input from several biological bodies and remote vision and telepathy might involve signals from brain reflected to a second brain via multi-brainy magnetic body. Magnetic bodies could be associated also with “dead” matter.

In this picture the case of Miss Z could be understood in two alternative ways. A dark photon beam possibly created by the visual representation of the random number (does “dead” matter generate sufficiently intense beams of this kind?) and reflected by personal magnetic body could be in question. Alternatively, the magnetic body involved could receive the information about random number from the brain of the experimenter and reflect it to the brain of the subject person.

### Why does electrical stimulation induce OBEs?

Electrical stimulation of angular gyrus induces OBEs just as the stimulation of neurons of temporal lobe induces long term sensory memories. In neurological “brain only” approach the interpretation would be that the responses in the vestibular and somatosensory system induce the AS and OBE as hallucinations. In TGD framework the response in vestibular and somatosensory system would be interpreted as a response to an actual experience of being in a detached position and orientation, and brain would process genuine sensory data about being in detached position.

One might think that the temporal ordering between the experiences and these responses would allow to decide which causes what. In TGD framework negative energy signals propagating backwards in the geometric time are however a basic element of brain functioning and this criterion need not be apply.

One imagine two mechanism generating OBEs.

1. The mechanism inducing visual OBE and related experiences could simply turn off the ordinary sensory input so that only the dark photon beams from the magnetic body and reflected back from biological body would contribute to the visual stimulus. This would occur automatically during dreams and NDE experiences.
2. The sensory input from the magnetic body could be amplified. Time mirror mechanism (see **Fig.** <http://tgdtheory.fi/appfigures/timemirror.jpg> or **Fig. ??** in the appendix of this book) could be responsible for this amplification [?]. During epilepsy strong electric fields generated by brain during epilepsy induce starvation of neurons and the electrical stimulation of angular gyrus could have the same effect. Starving neurons would generate a beam of phase conjugate (negative energy) dark photons received by magnetic body in order to get metabolic energy. The magnetic body would be in a state analogous to a population inverted (possibly many-sheeted) laser defining a hologram like representation of the body. The receipt of negative energy photons would induce a cascade like induced return to the ground state and amplify the dark photon beam arriving from magnetic body so that it would not be masked by the ordinary visual input anymore and would give rise to a percept.

### 4.6.3 Dark Matter Hierarchy, Zero Energy Ontology, Negentropic Entanglement, OBEs

Dark matter hierarchy, zero energy ontology, and the notion of negentropic entanglement lead to new insights also about OBEs.

#### Basic ingredients of the TGD inspired model

The model of OBEs involves several ingredients that are specific to TGD.

1. Magnetic bodies and field bodies are excellent candidates for the “third person” seeing the ordinary body. Magnetic body could receive a visual stimulus from ordinary body and reflect it back as a visual stimulus during OBE processed by the brain of the subject person. Thus body would see itself from the perspective of the magnetic body. Also dreams and hallucinations might involve the same mechanism. In the case of hearing sounds created by subject person could be reflected back to her ears or more plausibly, microwave hearing [I18] could be involved.
2. Topological light rays (“massless extremals”, MEs) are an element of TGD having no counterpart in Maxwell’s ED and play a key role in TGD inspired theory of consciousness. The interpretation of MEs has remained somewhat obscure. The development of TGD based model for dark matter residing at magnetic flux tubes and characterized by large value of Planck constant implying quantum coherence in even macroscopic length and time scales changed the situation in this respect. The model for dark matter as macroscopically quantum coherent phase is discussed briefly in this book in chapter [K65] and more extensively in the book “Genes, Memes, Qualia, and Semitrance” [K28]. MEs can be identified as space-time correlates of Bose-Einstein condensates (“laser beams”) of dark photons. It is however still unclear whether ordinary laser beams actually correspond to dark photon Bose-Einstein



condensates and become visible only in de-coherence to ordinary photons. Negative energy MEs can be identified as correlates for phase conjugate laser beams of dark photons. The so called time mirror mechanism is universal building block of basic biological and brain functions [?].

3. Bio-systems as conscious holograms is one of the key ideas of TGD approach [K12]. Bio-holograms [I42] suggest themselves as primary sensory stimuli quite generally. Biological body could generate dark photon “laser beams” received by magnetic bodies and reflected back to retina or perhaps to pineal gland [J31], the “third eye”. This would explain AS as well as the images of internal organs [J78]. Also other systems, at least living systems, could be seen from the perspective of the magnetic body. Remote vision hypothesis testable by using living targets not visible in ordinary sense. This would give also rise to telepathy if reflection occurs from magnetic bodies of another person.
4. In TGD framework sensory organs are identified as seats of primary sensory experience and brain only constructs symbolic representations about percept, in particular identifies objects of perceptive field. This does not exclude a considerable back projection to sensory organs modifying the sensory input. Dreaming involves back projection to sensory organs inducing artificial sensory experiences as simulation. One possibility is that dreams and hallucinations represent direct back projection to sensory organs along neural pathways. An alternative view is that the projection involves dark photon beams generated by brain and reflected back from the magnetic body. If OBEs are hallucinations, the visual sensory memories of the subject person about herself could serve as building blocks to generate simulation about what person looks like when seen from outside.
5. Sharing and fusion of mental images is one of the basic notions of TGD inspired theory of consciousness [?, K12]. One can ask whether OBE involves sharing of the visual experience of other persons involved about subject person. If this were the case, the presence of other persons would be necessary to have OBE. Sharing of mental images would explain the case of Miss Z as telepathy.

### Dark matter hierarchy

The identification of dark matter as a hierarchy of quantum phases labeled by the values of Planck constant [K33] provides additional insights about OBE experiences. Planck constant is quantized and can have arbitrarily large values and since Compton length and other analogous quantum lengths and times scale as Planck constant, this means macroscopic and macro-temporal quantum coherence and a reduced rate of dissipation.

Also the magnetic body controlling biological body (actually onion-like hierarchy of them) is assumed to carry dark matter and (forgetting ontological delicacies) dark matter could be seen as the agent responsible for the quantum control of ordinary matter in living systems. The value of Planck constant becomes also a measure for the evolutionary level of the living system and great leaps in evolution can be identified as transitions increasing the maximum value of  $\hbar$  in “personal” hierarchy of magnetic bodies [K29].

### Zero energy ontology and causal diamonds

Zero energy ontology is second new element of quantum TGD and states that all physical states have vanishing net values of conserved quantum numbers. Zero energy ontology provides a firm justification for the notion of negative energy signals consisting of (say) phase conjugate photons propagating to the geometric past. These negative energy signals are crucial element of the time mirror mechanism playing a central role in the general mechanism for intentional action, remote metabolism, and long term memory.

Causal diamond (CD) defined roughly as the intersection of future and past directed light-cones serves as an embedding space correlate for zero energy state. Space-time sheets representing zero energy states are inside CD and the future *resp.* past boundaries of CD carry positive *resp.* negative energy parts of zero energy states.

What is important from the point of view of consciousness theory is that CDs serve as embedding space correlates of selves and sub-CDs as those for sub-selves (mental images). Sub-CDs are very much analogous to music instruments in the sense that the frequencies which come as harmonics of the fundamental frequency defined by the proper time distance between tips of CD (coming as powers of two) resonate with the geometry of CD and put it to “ring”. Sub-CDs could be seen as an analog of radio receiver as far as sensory representations are considered and sending antenna as far as the motor control of biological body is involved. This allows to communicate sensory data from brain to sub-CDs at magnetic body CD in a highly selective manner. MEs (massless extremals) mediating the communications between magnetic body and biological body are also very much like strings of a music instrument. This picture generalizes the earlier music metaphor applied to axonal pathways.

A more precise definition of CD is as the Cartesian product of the intersection of future and past directed light-cone with  $CP_2$ . The hierarchy of Planck constants brings in additional structure. There is identification of preferred  $M^2 \subset M^4$  defining a preferred time direction (rest system/quantization axis for energy) and spin quantization axis. The preferred geodesically trivial sphere  $S^2 \subset CP_2$  and the selection of point assigned with  $CP_2$  at the future and past boundaries of CD gives rise to a selection of quantization axes of color isospin and hyper charge.

Sensory representations are a key element of the consciousness theory and the moduli space of CDs characterizing what kind of CDs are possible brings in new representational resources.

1. The moduli space of sub-CDs involves the position for the either tip of the sub-CD and the naïve expectation is that this position could code for the position of the perceptive field. If so the representation would be very concrete and since the size of CD is already for electron with 1 lightseconds the representations is realized automatically in astrophysical scale.
2. The moduli space of sub-CDs assignable to the mental images with another tip fixed could represent geometric qualia. Without any further restrictions this space corresponds to proper time constant hyperboloid of future light cone. The values of time parameter come in powers of two. One can however quite well consider the possibility that only a discrete lattice of the hyperboloid is realized- at least in the intersection of real and p-adic worlds.
3. A Lorentz boost for sub-CD induces scaling of frequency and scaling of the object in the direction of the boost. Therefore boost coded to the fundamental frequency of CD could code for various shapes of a figure obtained by scaling. Boost of sub- $CD$  leaving the other tip of sub- $CD$  invariant could also code for the velocity of object. Also the velocity of the object of the perceptive field could be coded to the shape of sub-CD by performing corresponding Lorentz boosts to it [K76].
4. The moduli space of CDs contains also the choice of quantization axes of energy (preferred rest system) and spin as well as the choice of quantization axes of color isospin and hyper-charge identifiable as flag manifold  $SU(3)/U(1) \times U(1)$ . Mathematician Barbara Shipman has proposed that this flag manifold is involved with the representation of geometric data in honeybee dance [A4] and I have proposed a model for what might be involved [K37].

The moduli space of CDs is thus highly relevant for the representation of the geometric data associated with the objects of the perceptive field and the this data would be communicated using MEs with harmonics of the fundamental frequency of sub-CD so that sub-CD would act like radio receiver. This includes the position of the real object codable to the position of sub-CDs at magnetic body, the velocity of the object of the perceptive field codeable to the Lorentz boost changing the shape of sub-CD and represented as scaling of the frequency assigned with the stationary object. Also the shape of perceptive field would represent this kind of geometric data. This picture supports the interpretation of sub-CDs as spotlights of attention giving information about many-sheeted space-time inside the regions defined by the sub-CDs. It would seem that sub-CDs are dynamical objects created, destroyed, and shifted in quantum jumps. This picture is also consistent with the explanation for the arrow of psychological time based on zero energy ontology [K106].

### Negentropic entanglement

The third new element is the notion of negentropic entanglement (see **Fig.** <http://tgdtheory.fi/appfigures/cat.jpg> or **Fig. ??** in the appendix of this book) making sense when entanglement probabilities are rational or even algebraic numbers. Negentropic entanglement makes sense in the “intersection of real and p-adic worlds” consisting of partonic surfaces whose mathematical representations make sense both in real sense and p-adically. Negentropic entanglement is possible also between different number fields in accordance with the idea that cognition corresponds to p-adic number fields and cognitive representations are realized in the interactions of realities and p-adicities. Living matter is identified as matter in the intersection between real and p-adic worlds. This view together with zero energy ontology allows precise definition for the idea that intentional acts transform p-adic space-time sheets to real ones and for the reversal of this transformation [K52].

It is natural to assume that negentropic entanglement is what makes living matter living and is involved with the sharing of mental images and with the formation of sensory representations by entanglement. Negentropic entanglement can be also time-like. MEs are excellent candidates for mediating this kind of entanglement whereas magnetic flux tubes would naturally mediate space-like negentropic entanglement. The sequence of negentropic entanglements would have as its upper ends sub-CDs at highest layer of the magnetic body and sensory organs as its lower ends. Even sensory organ could have negentropic entanglement with the real object of the perceptive field and this might be crucial element in the construction of the sensory representations. For instance, the deduction of distance of the object of perceptive field might rely on interferometry using the dark variants of visible photons with wave length which is of the order of the distance to the object.

### OBEs in more general framework

A general model for the remote mental interactions follows from a model for the living matter by assuming that also other biological bodies can serve as targets for the control action of the magnetic body or communicate sensory information to the magnetic body. The notion of negentropic entanglement favors biological systems as targets but it is of course an open question whether also “dead” matter could have negentropic entanglement with its magnetic body. Ordinary intentional action would represent a particular case of remote mental interaction in this framework.

Consider now OBEs in this general framework.

1. During OBE experiences the mental images constructed by brain about biological body could be absent due to the absence of the metabolic energy feed to the appropriate parts of brain taking care of the construction of cognitive mental images about biological body and communications of them to the magnetic body. The simplest representation would be in terms of bit sequences with bit 1/0 represented in terms of population inverted state/ground state of many-sheeted laser. Negative energy signals to the geometric past would be used to read these signals by inducing partial reduction of the population in inverted states. In absence of metabolic energy feed 1: s would gradually transform to 0: s. It is however essential that time-like negentropic entanglement is involved besides classical communications. This would make it possible to share the mental images.
2. In absence of these cognitive mental images to the magnetic body, magnetic body would not anymore provide strict cognitive representations of biological body and virtual world experiences would result. Since only magnetic body would contribute to the bodily experience, the low rate of dissipation due to large value of  $\hbar$  would explain the pleasant experience about the absence of the sensory noise.
3. This general picture could also explain why OBEs seem to correlate with neural disorders such as epilepsy and disorders relating to perturbed body image. During this kind of disorders the feedback provided by the sensory and cognitive input would be lacking from the brain regions suffering the neural disorder and magnetic body would be solely responsible for the body image. The lacking strict correspondence between the conformations of magnetic body and biological body would mean that the experience is hallucination from the point of view of biological body. At the embedding space level the “conformations” of the magnetic body could be rather abstract and represented in terms of positions and other moduli of sub-CDs.

#### 4.6.4 A More Detailed Model For OBEs

In the following a more detailed model for various aspects of OBEs is developed.

##### **Do bio-photons result from the de-coherence of dark photon beams?**

Bio-holography provides support for the body as a hologram (more precisely, dark photon hologram). For instance, an electric stimulation of ear during Kirlian imaging of a finger tip creates a Kirlian photo from which it is possible to abstract a hologram of ear [I42] (for a TGD based model see [K12, K40]). This suggests that body parts can in some sense “see” each other. In particular, brain can “see” body parts (note that bacteria possess a primitive IR vision based on micro-tubules): this of course need not correspond to a conscious vision at our level of self hierarchy.

The biological function of bio-photons [I20] is poorly understood, and they are an excellent candidate for ordinary photons resulting when dark photon beam de-coheres. TGD based model of bio-photons can be found in [K43] and the identification as dark photons is discussed in [K28]. The findings of Peter Gariaev about the effects of visible laser light on DNA [I17] and so called phantom DNA effect [I16] provide a further support for the biological importance of bio-photons (see the discussions in [K28, K43]).

##### **What is the mechanism of out-of-body hearing?**

Mechanism could be even more general and work also in the case of other qualia. In particular, hearing might involve similar reflection of sound waves at larger space-time sheets from the magnetic body and heard as “other-worldly” sounds.

A more plausible option is that the auditory sensation is generated by dark microwave photons reflected back from magnetic body. Microwave [K73] [I18] is indeed a well-known but poorly understood phenomenon and the generation of microwaves by plants after sunset correlates also with taos hum [I24] (see the discussion in [K45]) which does not generate any response in microphones but reflects the features of the acoustic environment.

The auditory and visual hallucinations of schizophrenic persons would represent in this framework a genuine sensory input. The notion of bicameral mind introduced by Jaynes [J57] discussed in TGD framework in [K84] would fit also nicely with this picture. The “god” controlling the behavior of bicameral by giving explicit commands would correspond to some magnetic body, not necessarily that of the subject person, but a magnetic body receiving input from several brains in the social group and representing collective consciousness.

##### **Where are the sensory receptors giving rise to the primary sensory experience?**

The simplest guess is that the visual stimulus from the magnetic body is received by eyes. The fact that REM accompanies visual dreaming supports this view in the case of dreams. The receiving sensory organ could be also pineal gland [K16, K77], “third eye”, the seat of the soul according to Descartes [J31]. Pineal gland is known to contain retinal pigments and its counterpart in more primitive animals is known to function as a genuine eye. A simple test in the case of artificial OBEs is to look whether the electric stimulation of OBEs generates also REM.

If OBE hearing is indeed microwave hearing, the identification of the primary sensory receptors is not obvious, although their existence cannot be denied.

The insect olfaction relies on infrared light as discovered by Callahan [I37] (see the discussion in [K37]). One might therefore wonder whether also humans possess olfactory receptors sensitive to IR light, and whether the emission of dark IR photons reflected from magnetic body could play some role in olfaction and in the generation of olfactory hallucinations. One can even ask, whether the molecular recognition mechanism underlying chemical senses relies on IR light. It is known that human nose contains so called vomeronasal organ [J2] sensitive to odors having sexual or social meaning but that these odors do not give rise to a conscious experience.

It is known that blind persons can learn to “see” when their skin is stimulated by electromagnetic fields representing the environment. Perhaps dark photon beams could induce also tactile sensations. Quite generally, the earlier proposal that information in all sensory modalities can be transformed to field patterns represented by MEs could sharpen to the hypothesis that the

information in various sensory modalities allows a representation as dark photon beams inducing corresponding sensory qualia in the interaction with appropriate sensory receptors.

### **What is the mechanism causing the kinesthetic sensations during OBEs?**

The model should also explain sensations of lifting, flying experiences, and the experiences of being in translational or rotational motion. The motion of the magnetic body with respect to the physical body should induce this kind of sensations. The basic idea is simple: generalize the mechanism allowing to hear the motion of a sound source. Generalizing from sound waves to dark photon beams, the sensation in question would be basically due to the Doppler shift of the dark photon beams travelling between biological body and the moving magnetic body. The change of the dynamical hologram resulting in the interference of a bodily reference beam and Doppler shifted reflected beam in quantum jumps could be responsible for the sensation.

This model could also resolve an objection against the hypothesis that sensory receptors experience the primary qualia. The objection is based on train illusion. When you sit on a train and look at second train which starts to move, you can have an illusion that it is your train that moves. The illusion is not a mere belief but involves a sensation of acceleration in the entire body. There are two options.

1. The sensation is a response to various bodily activities induced by the belief of being in an accelerated motion.
2. The sensation is caused by a primary sensory input induced by the acceleration. This sensory input must be produced artificially in the case of train illusion.

Consider first a genuine accelerated motion of the biological body. One could argue that in absence of visual, auditory or other sensory information about being in accelerated motion, there is no belief about being in accelerated motion so that acceleration is not perceived at all for option a). This makes option a) implausible. For option b) the acceleration of the biological body with respect to the object defining the rest system is directly perceived. The Doppler shift of the dark photon beams radiated from biological body and reflected back from the rest system would induce the sensation. Reflection could occur either from the rest system or a magnetic body associated with it.

One can imagine two mechanisms creating an illusory acceleration for option b).

1. If the fixation of the attention to the moving train means the presence of dark photon laser beams connecting biological body and train or a magnetic body associated with it, the Doppler shift of dark photon beams could induce the sensation of acceleration.
2. Directed attention could cause a personal magnetic body to mimic the motion of train so that the relevant part of it deforms in the direction of moving train to keep the distance to the moving train fixed. This would induce train illusion by the same mechanism as in case 1).

For both mechanisms the reflection of dark photon beams becomes the fundamental mechanism of directed attention. Attention would mean a formation very concrete bonds between subject and object or a representation of object at the personal magnetic body: the rays connecting the eyes of cartoon characters would represent a very profound idea about consciousness. Both views about attention mean a clear-cut deviation from the prevailing neuro-scientific thinking according to which the experienced world is virtual and completely detached from the real world.

Cliff illusion might be an appropriate name for the disgusting feeling in stomach which one feels on the brink of a precipice. Sensory imagination about falling down is in question and could be induced by the deformation of the personal magnetic body such that it mimics free fall.

The floating sensations and strange deformations of personal body during OBEs could also correspond to the deformation dynamics of the magnetic body which could be also caused by external influences. If the size of the magnetic body is measured using Earth radius as a natural unit and if the personal magnetic body co-rotates with Earth, the variation of the effect of the solar wind could induce periodic deformations of the magnetic body as in the case of Earth's magnetic field. This could reflect itself as diurnal alterations in the shape of the body experienced during

OBEs: a contraction during day time and an elongation during night time. Sunspot maxima induce magnetic storms and these could have strong effects on the shape of the body perceived during OBEs.

### **What is the mechanism making possible to see internal organs?**

Becker tells in his book “Cross currents” [J78] about a young cancer patient who told that he can see the interior of his own body. The patient could also locate the remnant of the tumor correctly. The simplest explanation is that magnetic body at some level of hierarchy reflects the dark photons emitted by the internal organs.

Usually this does not occur and one should understand why the emission occurred in the case of the cancer patient. There is evidence that bio-photons leak out from non-healthy organs [I20]: this might mean that organs send more intense dark photon beams reflected at the magnetic body.

Time mirror mechanism involving time reflection instead of ordinary reflection suggests itself as an alternative explanation. The cells suffering starvation generated phase conjugate dark photon beams in order to get metabolic energy. This in turn induced a cascade like emission of positive energy dark photon beams from the magnetic body instead of mere time reflection.

### **4.6.5 The Role Of The Magnetic Body In The Case Of Other Brain Functions**

During the construction of the model of OBEs it became clear that the reflection of dark photon beams from the magnetic body could serve as a building block of several ordinary brain functions. It has been already found that dark photon beams could define a fundamental mechanism of directed attention.

#### **Dreams and hallucinations and magnetic body**

The reflection of dark photon beams from the magnetic body could be involved also with dreams and hallucinations so that the neurological similarity of AS experiences and OBEs does not mean that both are hallucinatory. The “subtle body” assigned by many spiritual traditions with the dreaming state (for a nice summary see [J62] ) would correspond to the magnetic body. In this case mental images constructed in brain would induce dark photon beams sent to magnetic body and reflected back. The mechanism would also naturally explain autoscopic and heautosopic experiences, in particular the ability to see internal organs.

#### **The relationship of EMDR experiences to OBEs**

Near-death experiences are not the only manner to get convinced about life after death. So called eye-movement de-sensitization and reprocessing (EMDR) discovered by Francine Shapiro [J18] induces what could be interpreted as after-death communications (see the discussion in [K75] ). The experiences of subject persons are claimed to be induced by this therapy in a highly reliable manner: according to [J18] 98 per cent of patients willing to participate the therapy had after death communication experience. It does not matter what the religious convictions of the subject person are and the experiences are actually rather easy to induce. It does not matter if the loss is traumatic or not or whether it is recent or occurred for decades in past.

The experiences resemble near death experiences (light tunnels, beautiful landscapes) and involve spiritual contact with the deceased. The EMDR technique involves getting the patient to move his or her eyes in a particular rhythmic fashion while at the same time attending to a particular aspect of the traumatic memory. How EMRD works is poorly understood as yet: possibly the fact that the shifting of eyes leads to increased brain processing is of importance. Notice that rapid eye movements REM are also involved with dreams.

A possible explanation is that EMDR experiences involves visual communication using dark photon beams and/or their phase conjugates with the 4-D magnetic bodies of the deceased ones located possibly in the geometric recent or past via the magnetic mirrors associated with them. Essentially the same mechanism as involved with long term episodal memories could be in question: the only difference would be that the magnetic mirrors now mediate information not from own 4-D body from the 4-D body of the deceased.

### Third person aspect of conscious experience

Our conscious experience involves so called third person aspect giving a symbolic bird's eye of view about ourselves. Magnetic body could take the role of the third person. At the fundamental level this representation could be based on sensory stimuli originating from body and reflected back to sensory organs. It would be completely masked by the ordinary sensory input in wake-up state but distilled by brain from the dominating sensory input and coded to a cognitive representation to minimize the amount of irrelevant information. A strong interference of this kind of sensory representation with ordinary sensory input would be obviously highly undesirable. The third person aspect could be present always and be based on the reflection of dark photons along MEs parallel to magnetic flux tubes.

### Feedback to primary sensory organs via reflection from magnetic body

One objection against the hypothesis that primary sensory organs are seats of sensory qualia is that sensory stimuli are only the raw material sculptured into actual sensory perceptions and that directed attention chooses what aspects of sensory stimulus are amplified and which neglected. I have proposed that there is a feedback by projections to the primary sensory organs from brain generating artificial sensory stimuli modifying the primary sensory input. This feedback could be realized also as a reflection of artificial dark photon beams generated by brain from the magnetic body and received as such by eyes or received by brain and channelled to eyes via MEs parallel to visual pathways.

### Does imagination involve feedback via magnetic body?

One can wonder, whether also imagination could involve reflection of dark photon beams from the magnetic body. In TGD framework the hypothesis that sensory qualia are generated at primary sensory organs and brain constructs only symbolic representations about experiences circumvents the basic objections such as the experience of phantom leg. In this framework imagination and cognition can be identified as symbol generating activities which are not initiated at sensory organs but at some higher level of the hierarchy starting from sensory organs and ending at the associative areas of cortex.

Imagination could however involve also transformation of symbolic representations to dark photon beams reflected back from the magnetic body. This input would not contribute to sensory input but might be abstracted from the sensory input and might serve as a kind of feedback. In absence of ordinary sensory stimuli the input from the magnetic body would dominate and imagined mental images would transform to dreams or hallucinations.

### Sensory memories and magnetic body

In some exceptional cases often associated with a serious damage in cognitive areas of brain the feedback from the magnetic body could give rise to a genuine sensory representation making possible direct sensory memories. Examples are autistic persons with ability to remember visual scenes music pieces in every detail and also reproduce them.

One explanation is sharing of sensory mental images of geometric past. An alternative explanation is that the information about sensory memory is communicated from the geometric past in symbolic form and transformed to a dark photon beam reflected back from the magnetic body. The fact that angular gyrus is involved with the translation of written language to internal speech and the abstraction of meaning of visual metaphors supports the view that a transformation of linguistic statements to concrete images projected to the magnetic body occurs in this process.

I have proposed a mechanism [K76] explaining synesthesia. The association of different sensory modalities could also occur via a transformation of sensory input in given modality to dark photon beam reflected from magnetic body and generating a sensation in another modality. Synesthetes are also known to be capable of amazing sensory memory feats [J74] and I have proposed an explanation based on time mirror mechanism [K76]. Also in this case neurons in certain region of left brain hemisphere suffer starvation which should be lethal by standard wisdom.

As a matter fact, the starvation mechanism seems to be a very general mechanism: Callahan has found evidence that insects find more easily the plants suffering from under nutrition [I33] (see

the discussion in [K39] ). Even the fasting common in spiritual practices could be seen as a method to get body entangled with magnetic bodies by using time mirror mechanism.

#### 4.6.6 Psychedelics Induced Experiences And Magnetic Body

There is a book about psychedelic induced experiences titled as “Inner paths to outer space” (<http://tinyurl.com/gnb4bp9> ) written by Rick Strassman, Slawek Wojtowicz, Luis Eduardo Luna and Ede Frecska [J45]. It took some time to realize that I have actually have met the Luna and Frecska.

The natural TGD inspired hypothesis to be discussed in sequel in detail goes as follows.

1. Psychedelics bind to the same receptors as the neurotransmitters with similar aromatic rings (weaker assumption is that neurotransmitters in question possess aromatic rings). This is presumably consistent with the standard explanation of the effect of classical psychedelics as a modification of serotonin uptake. This binding replaces the flux tube connection via neurotransmitter to some part of the personal magnetic body with a connection via psychedelic to some other system, which might be even in outer space. A communication line is created making among other things possible remote sensory experiences.

Magnetic fields extending to arbitrary large distances in Maxwell’s theory are replaced with flux tubes in TGD framework. The magnetic bodies of psychedelics would carry very weak magnetic fields and would have very large  $h_{eff}$  - maybe serving as a kind of intelligence quotient.

2. This would be like replacing the connection to the nearby computer server with a connection to a server at the other side of the globe. This would affect the usual function of transmitter and possibly induce negative side effects. Clearly, TGD inspired hypothesis gives for the psychedelics much more active role than standard hypothesis.
3. Psychedelics can be classified into two groups depending on whether they contain derivative of amino-acid trp with two aromatic rings or phe with one aromatic ring. Also DNA nucleotide resp. its conjugate have 2 resp. 1 similar aromatic rings. This suggests that the coupling between information molecule and receptor is universal and same as the coupling between the two bases in DNA double strand and consists of hydrogen bonds. This hypothesis is testable since it requires that the trp:s/phe:s of the information molecule can be brought to same positions as phe:s/trp:s in the receptor. If also protein folding relies on this coupling, one might be able to predict the folding to a high degree.
4. A highly suggestive idea is that molecules with aromatic rings are fundamental conscious entities at the level of molecular biology, and that more complex conscious entities are created from them by reconnection of flux tubes. DNA/RNA sequences and microtubules would be basic examples about this architecture of consciousness. If so, protein folding would be dictated by the formation trp-phe contacts giving rise to larger conscious entities.

This model meets of course strong objection: finite light velocity does not allow communications with outer space in standard physics framework. In TGD framework Zero Energy Ontology changes the situation. Second objection is that the communications require huge amount of energy unless they are precisely targeted. The third objection is that quantum coherence in very long, even astrophysical scales is required. In TGD framework these objections do not apply.

#### Some background about psychedelics

Psychoactive drugs can be classified into three basic types. Some raise the activity level (excitation), some calm down (inhibition), and some change the character of consciousness profoundly. Psychedelics/hallucinogens [J45] belong to the third group. Psychedelics (such as psilocin, psilocybin, DMT, LSD) containing aromatic rings and many of them (such as psilocin, psilocybin, DMT) attach to serotonin receptors.

As the official term “hallucinogens” implies, psychedelic induced experiences are regarded as hallucinations in the materialistic world view although the denial of the reality of subjective



experiences themselves requires a really hard-nosed skeptic. The title of the book reveals that the question posed in the book is whether these experiences could be about real world, kind of sensory input from distant parts of the Universe. The indigenous people using ayahuasca and similar psychedelics have regarded these experiences involving meeting of representatives of other civilizations as perceptions about real worlds. Also Terence and Dennis McKenna, who are pioneers of systematic study of the effects of various psychedelics, shared this view. In the materialistic ontology of standard physics this kind of interpretation is of course excluded. That hallucinations are in question is “obvious”, too obvious actually!

The classical psychedelics are psilocin and psilocybin contained by mushrooms, DMT found in ayahuasca, and mescaline found in peyote cactus. DMT is an endogenous psychedelic and there is pumping of DMT through blood-brain barrier so that DMT could have important brain function.

The aromatic ring structures of psychedelics and neurotransmitters (<http://tinyurl.com/d8636or>) involved provide a more concrete view about the situation.

1. Classical psychedelics are derivatives of two basic chemical groups: tryptamine and phenethylamine which in turn derive from the amino-acids trp and phe.
2. Trp (<http://tinyurl.com/y967c489>) is characterized by pair of aromatic rings (6-cycle and 5-cycle). Psychedelic psilocin (<http://tinyurl.com/yanyvhgl>), <http://tinyurl.com/blkp76t>, DMT (<http://tinyurl.com/osfg9r3>) have 2 aromatic rings. Neurotransmitter serotonin (<http://tinyurl.com/14h2g2y>) has also two aromatic rings.
3. Phe (<http://tinyurl.com/kr5cvud>) has single aromatic ring (6-cycle). Psychedelic mescaline (<http://tinyurl.com/cgw7nuv>) has single aromatic ring. Neurotransmitters dopamine (<http://tinyurl.com/bvxmwch>) and norepinephrine have one aromatic ring. Note that both serotonin, dopamine, and norepinephrine (<http://tinyurl.com/yaxyj9q6>) are associated with mood disorders: clearly control in long time scales is in question, which in TGD framework suggests very large size scales for the parts of magnetic body involved.
4. Remarkably, DNA and RNA nucleotides can be classified to those with two aromatic rings (pyrimidines A and G) and their conjugates with one aromatic ring (purines C, T and U). Note that also his and tyr are amino-acids (<http://tinyurl.com/jsphvgt>) with single aromatic ring (<http://tinyurl.com/yb492da6>). Information molecules involve often aromatic rings. For instance, hormones involve often complex rings structures. Also hydrophobic second messengers (such as cAMP) (<http://tinyurl.com/yajhj9zb>) involve aromatic rings.
5. LSD (<http://tinyurl.com/c112ox7>), which is synthetic psychedelic, has 3 6-rings and one 5-ring.
6. The classification of the neurotransmitter receptors (<http://tinyurl.com/cqyoref>) provides further insights. They are classified into two groups. Ligand gated receptors can be excited and inhibited by certain neural transmitters. G-protein coupled receptors (<http://tinyurl.com/y9qesr87>) modulate the actions of excitatory (glutamate, aspartate) and inhibitory neural transmitters (GABA, glycine). Most neural transmitters bind to G-protein coupled receptors and this is true for classical psychedelics and for serotonin, dopamine, and norepinephrine.

The first guess is that the presence of aromatic rings determines the character of the transmitter receptor pair and that G-protein coupled receptors having aromatic rings are above ligand gated receptors in the hierarchy and control them. They would correspond to two different levels in the hierarchy of magnetic bodies. Note that also LSD binds to G-protein receptors.

According to the book [J45], pineal gland might be in a special role concerning psychedelics.

1. Pineal gland is the only nucleus of brain, which does not appear as left-right pair: this suggests that its functions relate to a control of the entire brain in long time scales. Descartes regarded pineal gland as the seat of soul. Pineal gland is also known as “third eye” and in lower species it indeed serves the function of eye.

2. Pineal gland is responsible for the production of melatonin: the production rate varies with a circadian rhythm. Melatonin is a serotonin derived hormone and therefore has 2 aromatic rings: this suggests that the amount of serotonin is higher in pineal gland than elsewhere in brain. Melatonin helps in sleep disorders and affects also other parts of brain. One can ask whether melatonin is involved with establishing of distant flux tube connections during sleep - not only in pineal gland but also in other parts of brain - and whether these connections are built up during sleep.
3. There is some evidence that pineal gland can produce DMT from tryptamine (<http://tinyurl.com/osfg9r3>) *believed* to be released during dreaming, during spiritual and mystical experiences, and during the time of death. Taking the title of the book seriously, one can ask whether this eye is able to see also to cosmic distances possibly using large  $h_{eff}$  photons and whether DMT is involved.

### Could instantaneous communications in cosmic scales be possible in TGD Universe?

In TGD inspired ontology the notion of magnetic body with astrophysical, galactic or even supergalactic size changes the situation completely. The basic communication tool would be touch of magnetic bodies generating reconnections and making possible signalling from the biological body to the member of distant civilization. The perception of the biological body of alien would differ in no manner from that of my neighbor since the mechanisms would be the same as involved with the transfer of sensory data to my personal magnetic body and control commands from there to biological body (at least through genome).

The basic objection against the possibility suggested by the title of the book is that finite light velocity poses absolute upper bound for the distance of objects with it is possible to be in contact during “trip”. One must be however very cautious here: the assumption that signals propagate only to singlet direction of time is essential also and derives from classical thermodynamics. In TGD framework second law continues to hold true but the arrow of geometric time for zero energy states changes in each state function reduction occurring to the either boundary of CD. Hence instantaneous communications (“remote seeing”!) using reflection in time direction become possible even over cosmological distances and define among other things the mechanism of memory in TGD Universe.

Time consuming and expensive space travel would become un-necessary: our magnetic body giving us cosmic size together with zero energy ontology making possible instantaneous “seeing” of both future and past by reflection of photons in time direction would be enough. Memory and anticipation would be basic examples about seeing in time direction. This view would also resolve Fermi paradox. We could be actually in a continual contact with the distant civilizations but without realizing it. One can ask whether similar contacts could take place in psychedelic induced experiences. Memories and future plans would be examples of “seeing” in time direction. The continual re-creation of the Universe by quantum jumps would of course mean that the actual future/past need not be same as those which are “seen”. Shamans identify various plants as conscious entities teaching them - in TGD framework this would translate to magnetic bodies of representatives of distant civilizations remotely teaching the representatives of more primitive civilizations.

What is the precise meaning of the catchy phrases “communications with geometric past/future”, “time reflection”, and “seeing in time direction”.

1. The recent view about state function reduction in Zero Energy Ontology leads to a precise identification of self as conscious entity. Self corresponds to a sequence of state function reductions leaving the passive boundary of causal diamond (CD) invariant and also Zero energy states correspond to superpositions of state pairs at opposite boundaries of CD. State function reduction leaves the member of the state pair at either boundary of CD (call it passive boundary) invariant - this is the counterpart of Zeno effect.

In the analog of unitary evolution following each reduction the position of active boundary is shifted to geometric future and the state at it is changed. This is the counterpart of unitary time evolution at active boundary. The increase of the temporal distance between the tips of CD gives rise to the experienced flow of time. Negentropy Maximization Principle

(NMP) eventually forces the first reduction to the opposite boundary of CD: self dies and re-incarnates at the opposite boundary and growth of the CD continues at opposite direction. The new self has arrow of time opposite that for the old one. The first state function reduction generates negentropic entanglement and can increase the value of  $h_{eff}$  so that evolution becomes possible.

2. In this framework geometric memories correspond naturally to time reversed sub-selves defining mental images. The space-time region (active boundary of CD) wherefrom they receive sensory information is indeed in geometric past of the self so that the interpretation as episodal memory makes sense. Also classical communications are naturally associated with sub-self and its time reversal. Note that precognition is memory from the point of time-reversed self. During sleep we precognize our geometric future.

Consider now communications with distant objects in this framework.

1. Negative energy signal would mean death of sub-self representing mental images and its re-incarnation in the geometric past accompanied by negative energy signal received by the new sub-self. The death of the time-reversed sub-self generates a sub-self with original arrow of time receiving the accompanying positive energy signal. The dying sub-self sends a signal received by its re-incarnation!
2. Communications with distant parts of the cosmos would be experiencing the time reversals of one's own mental images! We would be quite literally cosmic entities. Study of cosmos would be study of our own minds. In this situation mind is only conscious about itself. If Mind is conscious about other Mind it must fuse with it to single Mind by generating negentropic entanglement, otherwise it has no experience about other Mind. As far as conscious experience is involved, there is only one Mind. This is the TGD analog for One Mind theory and is able to avoid the paradox.

If the sub-self representing self model dies as one falls in sleep and re-incarnates as its own time reversal at the opposite boundary of CD, sleep could involve communications with distant parts of the Universe. Pineal gland generating DMT could play a key role in this process.

### Why information molecules containing aromatic rings should be so important?

I have considered the question of the title in [L22] [K74] (<http://tinyurl.com/yatfreqe>). The basic idea is that aromatic ring can carry the analog of supra-current as electron pair and this current generates a dipole magnetic field represented as flux tubes around the ring. This makes molecules with aromatic rings basic conscious entities in living matter. The flux tubes can carry dark matter and if there are several molecules with aromatic rings near each other, reconnections can take place and give rise to larger structures with building bricks connected by pairs of flux tubes carrying supra currents and dark cyclotron photon signals.

DNA would be the fundamental structure of this kind. Each base-pair would contain  $1+2+1+1=5$  (two rings from sugars) aromatic rings and longer DNA sequences would define larger conscious entities. Microtubules contain also aromatic rings assignable to 2 amino-acids phe and trp appearing in the tubulin molecules. Of course, all proteins contain these aromatic rings possibly integrating by flux tube connections to larger conscious entities. In this picture it would not be surprising if the basic information molecules would also involve aromatic rings.

DNA letters A,G and their conjugates T,C have the ring structures of trp and phe respectively and base pairs in the double DNA strand correspond to trp and phe ring structures connected by hydrogen bonds. Could the information molecule-receptor protein coupling rely on similar couplings with trp and phe playing the role of fundamental plugs. This hypothesis predicts that more complex information molecule-receptor pairs should have geometries in which trp:s and phe:s can meet each other naturally. Also protein folding could involve similar trp-phe self-couplings by hydrogen bonds determining the folding to a considerable degree. Protein folding would be determined basically by the generation of negentropic entanglement dictated by NMP and its understanding would require quantum theory of consciousness.

### Psychedelic-receptor complex as plug-in to cosmic internet and a new perspective on remote seeing?

If one - just for fun - takes seriously the claims of shamans, one must ask whether our brain has well developed tools available for building contacts with distant civilizations and what these tools might be. The receptors of neural transmitters are obviously the natural candidates for the pathways to cosmos. In the case of neural transmitters these would serve as pathways to the personal magnetic body (with onion-like structure). Neural transmitters could be however replaced with psychedelics if they have a geometric structure allowing a binding to the corresponding receptors. If psychedelics have flux tube connections to very distant parts of the Universe, a connection is generated.

1. One can argue that evolutionary pressures have forced living matter to develop highly standardized connections to various parts of the personal magnetic body and possibly also other magnetic bodies. Personal magnetic body has astrophysical size and EEG frequencies would correspond to communications in Earth size scale. Receptors serving as Josephson junctions emitting Josephson radiation with frequency characterised by  $h_{eff}$  are natural candidates for plug-ins.
2. The model for cell membrane as Josephson junction leads at the microscopic level to the view that the proteins associated with various ion pumps, channels, and receptors (of also neurotransmitters in postsynaptic junction) define Josephson junctions to which magnetic flux tubes are associated and characterized by local value of Josephson frequency, that is membrane potential and Planck constant  $h_{eff}$ . As the information molecule is attached to a receptor, a connection to some part of the same magnetic body would be generated and split as the molecule is not present. These connections are possible in the scale cell, organelle, organ, organism, population and maybe even in the scale of cosmos. Psychedelics affect serotonin receptors so that serotonin spends longer time in receptor.
3. The simplest picture is that the connection corresponds to a pair of flux tubes. As the connection is broken, the pair has suffered reconnection cutting it to two U-shaped closed flux tubes. When molecule is attached to the receptor, these U-shape closed flux tubes reconnect. The actual situation is of course expected to be more complex but the basic principle would be this.
4. Neurotransmitters and also other information molecules can be seen as molecules at the ends of flux tubes having ends in some fixed subsystem X. The attachment of neurotransmitter to the receptor would build a flux tube connection between postsynaptic neuron and X. The magnetic bodies in question characterised by passwords defined by collections of cyclotron frequencies corresponding to a hierarchy of space-time sheets. The Josephson frequency associated with the receptor is inversely proportional to  $h_{eff}$ . The natural guess is that it corresponds to the cyclotron frequency of the magnetic body part for electron, proton, or some ion associated with it. Josephson frequencies should serve as kind of passwords and receptors would be in one-one correspondence with these passwords defining gateways even to the outer space if the value of Planck constant is large enough.

The basic difference to ordinary view is that information molecules build only connections: after the establishment of a connection dark supracurrents and dark photons take care of the communication. Attaching the information molecule to receptor is like clicking a link in web.

5. Psychedelics would replace the ordinary neural transmitters building up this kind of flux tube connections in the normal situation so that the connections could be to quite different places.

One might be able to test this crazy hypothesis.

1. Pineal gland could still serve as the “third eye” but utilizing large  $h_{eff}$  photons. Fishes and birds are able to navigate to their birth places. The strongest assumption is that the flux tubes connect birth place and place of migration.

This mechanism could involve dark electron Cooper pairs at the magnetic flux tubes of Earth’s magnetic field generated by visible photons with energies above energy of red light making

possible to move along magnetic flux tube. As the direction of flight ceases to be along it and spin direction of cyclotron Bose-Einstein condensate changes, cyclotron transitions would induce dark photon emission at energy of visible photons in turn generating visual sensation serving as a signal allowing to correct the direction of flight. This would explain why radiation at MHz frequency leads to disorientation (cyclotron transitions are induced resonantly).

This need not be enough. Could also “remote seeing” by pineal gland using the dark light coming along flux tubes (or maybe even active variant of this process by sending light which is reflected back in time direction). What about remote seeing in the “usual” sense of the word: could psychedelics help also in this process?

2. The role of DMT is especially interesting. Body synthesizes it and pumps it through blood-brain barrier. I learned in private discussion that the experiences induced by DMT are relatively predictable (Terence Mac Kenna has described it as a sudden “dropping” to another world somewhere “below” through some kind of wall) whereas other psychedelic substances induce rather unpredictable experiences.

Could it be that DMT corresponds to a permanent connection to some fixed external magnetic body or to a higher layer of level of personal magnetic body with permanent reconnection to some part other magnetic body? DMT as also other psychedelic substances would only help to induce the signal as Josephson radiation. This would be analog to the higher probability of remote mental interaction due to pre-bonding. What happens during sleep: is this connection generated during sleep: what about concentration of DMT during sleep in various brain regions.

3. The information molecule-receptor complex would be associated with the communications to a part of magnetic body determined by the flux tube assignable to the information molecule and possible communications from magnetic body as sensory experiences such as psychedelic experiences and mediated by radiation in opposite time direction. Also control commands from magnetic body - assumed to be realized as signals in opposite time direction as compared to sensory signals - are important and a natural assumption is that the commands initiating gene expression enter through genome via flux sheets traversing through DNA: the time scale for gene expression is slow and also other mechanisms are very probably involved. If both genome and cell membrane can (on general grounds it seems that they must do so) send signals in both time directions, the general vision about motor action as time reversal of sensory perception implies that cell membrane receives also control commands.

More generally, the complex formed by reacting biomolecules and catalyst could form a complex receiving control commands from the magnetic body. A temporary fusion of a catalyst molecule and of reacting molecules could serve as the analog of the information molecule-receptor complex. The protein Josephson junction associated with this complex would receive in a resonant manner cyclotron radiation from the magnetic body inducing a transition to a state in which the potential barrier preventing the reaction would be lower.

4. An interesting but ethically questionable test for the hypothesis would be following. Transfer neurotransmitters associated with the of subject B to the brain of person A, and see what effect they have on conscious experience of A. If the proposal is correct, person A would have flux tube connection to the magnetic body of B, and might receive some memories of B for instance. Could transplants induce similar effects? Heart transplants are reported to have strange effects suggesting that heart (having a lot of neurons) has emotional memories.

Irrespective of whether one takes seriously the thought game leading to this proposal, one must admit that it would provide deep for the notion of “information molecule”.

### Still about the mystery of DMT

In FB I got a link to a very interesting article about DMT (N,N-Dimethyltryptamine, see <http://tinyurl.com/y8qrp8tc>). DMT (see <http://tinyurl.com/osfg9r3>) is psychedelic or hallucinogen - depending on one’s attitudes. DMT is used for spiritual and healing purposes in many

cultures. The effect is short-lasting: from 5 to 15 minutes. DMT induces mystical experiences, euphoria, dynamical geometric hallucinations of geometric forms, experiences about meeting of higher intelligences, extraterrestrials, elves, and even God.

First some facts about DMT.

1. DMT is found in both plants and animals and is the only naturally occurring psychedelic. Its occurrence in the pineal gland of rodents and therefore also of mammals has been reported.
2. Chemically DMT is a structural analog of serotonin and melatonin and involves aromatic 6-cycle and 5-cycle with common edge appearing in amino-acid tryptophan (see <http://tinyurl.com/przan6k>). Also DNA nucleotides A and G have this double cycle structure but have however more than one nitrogen atom.
3. The biosynthesis of DMT from amino-acid L-tryptophan (occurring endogenously in plants but not in animals) has been detected in rabbit's lungs. Whether DMT is produced by brain is still an unsettled question. It has been even argued that DMT is mere waste.

In TGD framework aromatic cycles serve as indication that molecule contains paired valence electrons with the value of  $h_{eff}/h = n$  higher than its standard value: this explains the delocalization of electrons to longer than atomic length scale.  $n$  would serve as a kind of intelligence quotient: the larger the value of  $n$  is, the larger the maximal value of entanglement negentropy of the system is (understanding of this statement requires going outside the framework of the mathematical framework of standard physics: I call this framework adelic physics [L37] [L38] (see <http://tinyurl.com/ybp74yf8>).

In this picture the interpretation as a waste does not look sensible and the proposal that DMT is produced by brain or some other parts of body looks more reasonable. Biology does not usually manufacture anything without purpose. Especially so, if the manufacturing process requires metabolic energy. The biosynthesis of DMT from tryptophan does not occur spontaneously and requires N-methyltransferase enzyme as a catalyst. Also the highly non-trivial positive effects of DMT on consciousness suggests that it cannot be waste.

To understand what the purpose of DMT could be, one must have some idea about sensory perception in TGD Universe (I have already earlier written about DMT and psychedelics [L18] (see <http://tinyurl.com/ycualn43>).

1. TGD view about sensory perception relies on the idea that sensory qualia are at the level of sensory organs: this view makes sense if one accepts macroscopic quantum coherence [L35] (see <http://tinyurl.com/yb99u6u8>). TGD based view about time (zero energy ontology (ZEO)) allow to circumvent basic objections such as phantom leg: pain in phantom leg would be sensory memory of pain and in geometric past when the leg still existed. These sensory memories can be produced by stimulating temporal lobes in any subject person. One also avoids the challenge of explaining why structures consisting of essentially identical neutrons can produce so different sensory qualia.
2. This model however requires virtual visual feedback from brain realized as dark photons, which leak to ordinary photons identifiable as biophotons with energied in visible and UV range. The presence of virtual visual input could explain why the retina has inverted structure not expected in engineerish thinking.

Sensory percept would be an artwork created by the perceiver. This conforms with the fact that when congenitally blind people receive their vision, they report only seeing of diffuse light. The percept would be a standardized sensory mental images emerging as an outcome of iteration in which dark photons signals travel forth and back and give rise to a pattern recognition by transforming sensory input to standardized input nearest to it.

3. Dark photon signals would travel along magnetic flux tubes between brain to sensory organs and even between brain and magnetic body (MB) in much longer scales. Flux tubes would give rise to a connection network analogous to a telephone network. This network would have permanent part and dynamical part consisting of switches allowing to connect two flux tubes to single flux tube by a short bridge. Information molecules such as neurotransmitters,

hormones, and messengers could act as switches/bridges: when the information molecule attaches to a receptor, the bridge is formed and signals can propagate.

Also nerve pulses could induce flux tube bridges between neurons of the neuronal pathway by using neurotransmitters and learning as amplification of synaptic connections would be essentially the gradual stabilization of these flux tube bridges. Nerve pulse patterns need not serve as communications inside brain but could only make possible communications in much shorter time scales using dark photons. For 1 meter long axons about million forth and back signals are possible during millisecond.

Nerve pulses would however frequency modulate Josephson radiation from the generalized Josephson junctions defined by membrane proteins serving as ion channels. This modulation would code nerve pulse patterns to signals to MB mediated by EEG: EEG could also have fractally scaled variants corresponding to various layers of MB. This would explain the function of EEG.

4. Virtual sensory input need not always end up down to the sensory organs: there would be some kind of blocking stopping the virtual sensory input to higher level so that one would have only almost sensory percept: an imagined sensory experience. The virtual sensory input associated with imagination could proceed along different route than that associated with the buildup of percept. Also imagined motor actions would be halted motor actions. During REM sleep the blocking would not be present and the virtual sensory input would enter to sensory organs, in particular retina.
5. Pineal gland represents a kind of photoreceptor, “third eye”, which still serves as eye in some animals. Could the dark photons involved with imagination be received in pineal gland. Could they continue to travel to sensory organs during dreams and hallucinations? Pineal gland would be an organ of imagination besides serving as seat of soul! What is nice from the point of view of biological economy is that pineal gland would not be useless evolutionary remnant but would have found a new function.

Accepting this schematic view one can ask about the possible function of DMT.

1. DMT molecules could make possible REM dreams by providing the bridges making possible the propagation of dark photons to the retina. Pineal gland would be the natural relay station. Same mechanism could work for other sensory modalities if dark photons mediate the virtual sensory input transformed to ordinary percept at sensory organs. Also hallucinations would rely on this mechanism.
2. MB has very large layers, there is even evidence that galactic magnetic field is in contact with personal MB (personal MB could have flux tubes inside flux tubes of galactic magnetic field). Since magnetic field in Maxwellian world extends to infinity and since in TGD systems have field identity (field body/MB), one can even image that there are connections to distant civilizations with very weak magnetic field strengths at corresponding flux tubes carrying dark matter.

These connections could make possible a genuine sharing of sensory experiences and the encounters with ETs and alike could be genuine remote meetings! We might have these encounters during sleep quite routinely but would not remember anything since the sensory information would stop at the third eye! Only during dreams situation might change but also now sensory input would be virtual and represent imaginations.

**Remark:** I have told many times that I am working intensely and close my eyes lightly, I see a dim flow consisting of points and resembling an incompressible hydrodynamic flow. There are vortices and the flow goes back and forth. The flow lines are mathematically equivalent with field lines of a magnetic field in Maxwell’s theory and in TGD with flux tubes of MB in 1-1 correspondence with the points of the flow. Could this be seeing MB with the “third eye”?

## 4.7 Connection To The Work Of Researchers In Forefront

Here some examples about the work of other researchers possibly relevant for understanding remote mental interactions in TGD framework is discussed briefly.

### 4.7.1 Simon Shnoll

Shnoll and collaborators [E3, E7, E8, E4, E10, E5] have discovered strange repeating patterns of random fluctuations of physical observables such as the number  $n$  of nuclear decays in a given time interval. Periodically occurring peaks for the distribution of the number  $N(n)$  of measurements producing  $n$  events in a series of measurements as a function of  $n$  is observed instead of a single peak. The positions of the peaks are not random and the patterns depend on position and time varying periodically in time scales possibly assignable to Earth-Sun and Earth-Moon gravitational interaction.

These observations suggest a modification of the expected probability distributions but it is very difficult to imagine any physical mechanism in the standard physics framework. Rather, a universal deformation of predicted probability distributions would be in question requiring something analogous to the transition from classical physics to quantum physics [K5].

The hint about the nature of the modification comes from the TGD inspired quantum measurement theory proposing a description of the notion of finite measurement resolution in terms of inclusions of so called hyper-finite factors of type II<sub>1</sub> (HFFs) and closely related quantum groups. Also p-adic physics -another key element of TGD- is expected to be involved. A modification of a given probability distribution  $P(n|\lambda_i)$  for a positive integer valued variable  $n$  characterized by rational-valued parameters  $\lambda_i$  is obtained by replacing  $n$  and the integers characterizing  $\lambda_i$  with so called quantum integers depending on the quantum phase  $q_m = \exp(i2\pi/m)$ . Quantum integer  $n_q$  must be defined as the product of quantum counterparts  $p_q$  of the primes  $p$  appearing in the prime decomposition of  $n$ . One has  $p_q = \sin(2\pi p/m)/\sin(2\pi/m)$  for  $p \neq P$  and  $p_q = P$  for  $p = P$ .  $m$  must satisfy  $m \geq 3$ ,  $m \neq p$ , and  $m \neq 2p$ .

The quantum counterparts of positive integers can be negative. Therefore quantum distribution is defined first as p-adic valued distribution and then mapped by so called canonical identification  $I$  to a real distribution by the map taking p-adic  $-1$  to  $P$  and powers  $P^n$  to  $P^{-n}$  and other quantum primes to themselves and requiring that the mean value of  $n$  is for distribution and its quantum variant. The map  $I$  satisfies  $I(\sum P_n) = \sum I(P_n)$ . The resulting distribution has peaks located periodically with periods coming as powers of  $P$ . Also periodicities with peaks corresponding to  $n = n^+n^-$ ,  $n_q^+ > 0$  with fixed  $n_q^- < 0$ , are predicted. These predictions are universal and easily testable. The prime  $P$  and integer  $m$  characterizing the quantum variant of distribution can be identified from data. The shapes of the distributions obtained are qualitatively consistent with the findings of Shnoll but detailed tests are required to see whether the number theoretic predictions are correct.

The periodic dependence of the distributions would be most naturally assignable to the gravitational interaction of Earth with Sun and Moon and therefore to the periodic variation of Earth-Sun and Earth-Moon distances. The TGD inspired proposal is that the p-adic prime  $P$  and integer  $m$  characterizing the quantum distribution are determined by a process analogous to a state function reduction and their most probably values depend on the deviation of the distance  $R$  through the formulas  $\Delta p/p \simeq k_p \Delta R/R$  and  $\Delta m/m \simeq k_m \Delta R/R$ . The p-adic primes assignable to elementary particles are very large unlike the primes which could characterize the empirical distributions. The hierarchy of Planck constants allows the gravitational Planck constant assignable to the space-time sheets mediating gravitational interactions to have gigantic values and this allows p-adicity with small values of the p-adic prime  $P$ . "A Possible Explanation for Shnoll Effect" (see <http://tinyurl.com/ya9y6tx>) [K5].

What makes Shnoll effect so interesting is that it involves interaction of very long length scales with microscopic scales - even nuclear physics length scale as in the experiments of Shnoll. Similar situation prevails machine-mind interaction involving intention to affect sequences of random numbers generated by microscopic systems via quantum transitions. The proposed model suggests a mathematical description of the statistical distributions modified by the intentional action but leaves the interaction mechanism open. A possible mechanism could be a realization intentions as actions via a mapping taking p-adic space-time sheets representing them in long length scales to real space-time sheets in short length scales. In the recent case the field patterns would represent space-time sheets carrying classical fields inducing the desired effect at microscopic level on particles that have topological sum contacts to these sheets. Classically gauge forces would be in question and at quantum level modifications of various reactions rates caused by these fields.

This map would be carried out by the quantum counterpart of canonical identification or



its variant [K93]. The map would be characterized by resolution defined by power  $p^N$  of prime  $p$ . For powers of  $p^n$ ,  $n > N$ . the map would be continuous from p-adics to reals and for  $n < N$  it would be discontinuous and would correspond to the identification of reals and p-adic numbers via common rationals. I have discussed this kind of option based on ordinary canonical identification - actually one of the first ideas related to p-adic physics - in [K63, K61]. The main objection was that this map is not general coordinate invariant. This could however make sense since cognition breaks General Coordinate Invariance via a selection of a preferred coordinate system and bringing in the number theoretic anatomy of coordinate variables. I have also proposed (see <http://tinyurl.com/yc3jexng>) that the generation of cognitive representations and realization of intentional actions using canonical identification and its inverse could define the analog of T-duality of string theories, which also maps long and short scales to each other.

A more concrete model for the intentional action is obtained if one requires consistency with the model based on time mirror mechanism (see **Fig.** <http://tgdtheory.fi/appfigures/timemirror.jpg> or **Fig.** ?? in the appendix of this book) as a key element of intentional action. Canonical identification maps p-adic space-time sheet representing the intention and having the size of CD assignable to intentional agent and characterized by a typical macroscopic time scale (actually astrophysical since already electron corresponds to Earth sized CD with time scale of .1 seconds) to a much smaller space-time sheet representing a flux tube connection and possible accompanying massless extremal connecting the biological body of the operator and target. The classical fields carried by these space-time sheets would induce the microscopic effect realizing the intention.

### 4.7.2 Michael Persinger

Anyone - atheist or believer - wanting to learn about Persinger's work and the basic insights of neuro-theology should listen the extremely inspiring talk *God and the Brain - The Persinger "God Helmet", The Brain, and visions of God* (see <http://tinyurl.com/y83pq5v1>) by Todd Murphy [J6]. Persinger's work (for references to the articles by Persinger and collaborators see the Wikipedia article about God helmet at <http://tinyurl.com/3cpoyq>) suggests that the temporal pattern of the modulation of magnetic field strength (FM would be in question for slow variations) is important. We do not however know the "code". Also the strength of the magnetic field can be important. Note that the effects of very weak ELF em fields on vertebrate brain take place in amplitude windows [K29].

The modulation of magnetic field would probably induce FM of cyclotron frequencies. The TGD inspired model for hearing [K73] suggests this kind of modulation as a way to represent the frequencies of the sound wave. Also phase information is very important: time reversed speech sounds very different as normal speech but has the same power spectrum. Modulations would be slow in the time scales defined by the audible frequency range. .1 seconds would represent lower limit for the variation rate of modulation. Audible frequencies above 20 Hz.

The article "TGD Based View about Classical Fields in Relation to Consciousness Theory and Quantum Biology" (see <http://tinyurl.com/ycocvzmx>) contains a section considering a model for the findings of Persinger and collaborators using "God helmet". The spiritual experiences induced by "God helmet" could be interpreted as subjective experiences generated when the personal magnetic body receives an additional layer. For instance, manic-depressive bipolar cycle might be understood as a cycle in which euphoric period means the emergence of a new layer appears to the magnetic body and depressive period means its disappearance. I have also commented other findings of Persinger. God helmet might provide a technical tool to test the notion of magnetic body.

### 4.7.3 William Tiller

William Tiller in Stanford University has carried out impressive experimental work with what he calls intention imprinted electronic devices (IIED), and his results challenge that standard assumption that the intentions of experimenter do not affect the experimental apparatus [J87, J83, J84].

### Experimental arrangement

The goal was to try to imprint a specific intention into a simple, low tech electronic device so as to influence the companion, specific, well-designed, target experiment. The intentional imprinting was attempted in a meditative state. The intentionally imprinted device, IIED, was sent to a laboratory located at distance of about 1500 miles where colleagues had set up the experiment. The device was placed about 6 inches from a continuously running and computer-monitored target experiment and switched on (total electrical power rate was less than 1 microwatt). Over a time period of about 1-4 months the recorded results from the target experiment changed in the directions of the specific intention and the change eventually reached the selected magnitude of the specific intention. Also an identical, but not intention imprinted device was used and the results were compared in order to achieve more objective measurements about the effects of human consciousness on electric devices.

The targets used were purified water, some bio-molecules, and larvae of flies. These targets were either unshielded or shielded from radiation. For the latter purpose they were closed inside a grounded Faraday cage (FC), which screened rather effectively the radiation coming at microwave frequencies whereas for ultra low frequency (ULF) fields the screening is virtually absent (skin depth behaves as  $1/\sqrt{\pi\sigma f}$  at low frequencies and  $f = 2\pi\sigma$  (in units  $\hbar = c = 1$ ) defines kind of critical frequency above which screening occurs effectively). The targets could be affected by control device (CD) or by identical IIED generating microwave radiation. Radiation was generated either at single frequency (7.3 MHz) or at three frequencies (5.0, 8.0 and 9.3 MHz) [J85].

In the case of purified water the spatial distributions of physical parameters like pH, temperature, and conductivity were measured as a function time. In the case of bio-molecules the possible effect on thermodynamical activity, which measures the thermodynamical energy of single molecule, was measured. In the case of fly larvae the effect on the larval development time was studied. The results from various arrangements were compared with control targets (no FC, no CD, no IIED).

I have discussed a TGD based model for Tiller's findings the chapter

"Biosystems as conscious holograms" [K12] (see <http://tinyurl.com/ydx4fuk5>). The basis idea is that a connection between the magnetic body of operator and target is formed and the intentional imprinting involves magnetic fields and possibly also corresponding cyclotron frequencies. If one accepts the canonical identification as a map taking intention represented by p-adic space-time sheet to action represented by real space-time sheet in much shorter scale then the space-time sheets create would be microscopic space-time sheets carrying magnetic fields giving rise to the cyclotron frequencies.

The basic experimental results were two-fold. First of all intended effects were achieved. Secondly, the "conditioning" of the laboratory resulted as an unexpected effect and continued even after the removal of the target and IIED.

### Direct effects of the intentional action

1. IIED imprinted by intention to increase/decrease the pH of water gradually induced a shift in the pH of purified water to the intended value, increased the in vitro thermodynamic activity of bio-molecules, and a reduction of larval development time.
2. For bio-molecules and larvae four simultaneous side-by-side treatments were tested: i) an unshielded sample, ii) a shielded sample, iii) a shielded sample with an "on" control device, iv) a shielded sample with an "on" IIED. Just the shielding of em radiation affected the thermodynamic activity of the bio-molecules, and just adding less than about 1 microwatt of microwave radiation via control device reduced the thermodynamical activity and lengthened the developmental time. Thus the microwave radiation acted as a stressor having entropic effect. When the control device was replaced with IIED, the degradation caused by microwave radiation was overcome.

### "Conditioning" of the laboratory

Quite unexpected phenomena arose from a repeated conduct of IIED in a given laboratory space. By simply continuing to use IIED in the laboratory space, it became "conditioned in some very fundamental way". Three signatures heralded the onset of the "conditioning" process.

1. Oscillations of air and water temperature, and of pH and electrical conductivity of water with large amplitudes with the periods of oscillations in 10-100 minute range developed. The amplitudes of pH- and temperature oscillations was  $\sim \Delta pH = .1$  pH-unit and  $\Delta T \sim 1 - 3$  K units respectively. Even more remarkably, the oscillations were sustained in the locale even after the removal of the IIED suggesting kind of phantom effect analogous to phantom DNA effect. Oscillation amplitude had peaks at the harmonics of fundamental frequency  $f_l = 1/T_l$ ,  $T_l = 36.6$  minutes with three lowest harmonics being very clearly visible [J84]. Also  $T_l = 51.2$  minutes appears as fundamental period in some experiments. The ratio of these periods is 1.4 and rather near to  $\sqrt{2} = 1.41$ , which might relate to p-adic length scale hypothesis.
2. When an pH-increasing IIED with intention to increase pH by one unit was turned on in an almost unconditioned space located several hundred feet away from a strongly conditioned space, a well-defined pattern of pH-oscillations in an unconditioned space emerged. This pattern was accompanied by a highly correlated pattern of oscillations in strongly conditioned space. This kind of highly correlated oscillations were not observed in several unconditioned spaces - also located several hundred feet away.
3. The targets were subject to the action of a vertically aligned magnetic field in the range of  $10^{-2} - 5 \times 10^{-2}$  Tesla, such that the direction of the field could be reversed. In an unconditioned space the change of the direction of the magnetic field did not affect the pH. In the strongly conditioned space the effect on pH was different for the opposite directions of the applied field and the difference in pH values was about .6 units. One can say, that the target had become sensitive to the effects of external magnetic fields.

#### TGD based model for intentional imprinting

The model obtained by combining the model for Shnoll effect based on the canonical identification as a map taking intentions to actions with time mirror mechanism would suggest that intentional imprinting generates flux tubes between the target and magnetic body (MB) of operator and also those between target and biological body (BB) of the operator. These flux tubes would correspond to the images of p-adic space-time sheets representing the intention and having astrophysical size scale (or the order of the size of CD associated with operator). These flux tubes would connect BB and MB also to the nearby environment of IIED. The fact that nearby environment remains intentionally imprinted when target and IIED are moved away could explain why the effect remains as oscillations even when IIED is removed and why synchronous oscillations take place.

Negative energy signals would tend to generate negentropic effects eliminating the entropic effects if microwave radiation. This could explain why IIED reduces the entropic effects caused by microwave radiation. Cyclotron frequencies define natural candidates for the time scales involved. The magnetic fields in question would be of order 10-100 pT. The mechanism of compensation of the effects of cyclotron photons remains open. The simplest possibility is that microwave photons generated by IIED correspond to large  $\hbar$  phase conjugate photons with energies in the range of energies of microwave photons. The effects of negative energy large  $\hbar$  photons, which have suffered phase transition to ordinary positive energy microwave photons could induce the negentropic effects.

#### 4.7.4 About the double-slit experiment of Dean Radin

Dean Radin and his team have done a very interesting experiment [J43] (see <http://tinyurl.com/h44rns8> and <http://tinyurl.com/q7nbxnk>) testing the idea that observer induces state function reduction.

#### Experiment

The experiment is a modified double slit experiment. In double slit experiment a laser beam arrives to the screen via two slits and interference pattern is generated as if photons would behave like waves localized at screen. If one adds detectors at the slits, either detector fires and detects the passing-by by photon, and interference pattern disappears with optimal detection efficiency.

The idea is to add a subject person ( $S$ ) at distance of two meters.  $S$  imagines of measuring that electron passes through either slit. One can say that  $S$  intends to add a “detector” to either slit or both of them so that a state function reduction selecting either slit occurs. This experiment differs from experiments in which  $S$  tries to affect the ratio of frequencies of 0:s and 1:s in random series of bits:  $S$  does not try to force the electrons to pass by either slit. There is a feedback represented as sound/yellow light whose height/intensity coded for the amount of the reduction of the height of the peak. There are two kinds of participants: meditators and those who have no experience in meditation.

The results of the experiment are thoroughly discussed in the Youtube lecture or Radin (see <http://tinyurl.com/h44rns8>). To my opinion the results are amazing. In one experiment it was found that the height of the peak of the Fourier transform of the intensity distribution of the diffraction pattern is reduced. In second experiment the depth of bottom of the trough of distribution was reduced. As if the intention would induce with some probability to perform the measurement selecting the photon path. The effect was small but appeared systematically for a group consisting of meditators. For persons without experience in meditation the effect averaged out also in this case it was present in the beginning of the experiment when subject person were not bored by the repetitive character of the experiment. The longer attention span of meditators could partially explain this.

Even more amazing finding was that in a variant of the experiment realized in internet the results were also positive although the persons intending to induce the experiment.

### Arguments of skeptic

The standard argument of skeptic is that statistics is poor, that the experiment is even fraud, etc... One can however consider more refined and more imaginative objections. Let us make a digress from the usual behavior of skeptic and assume that the effect was real.

If the meditators could induce the measurement by intention, one expects that also the experimenter could have done it. To how high degree the outcome was due to the experimenters and how much due to the meditators? Experimenter also had the theoretical expectation that meditators are better in inducing the slit detection. Could the wish that the theory is correct have caused subconscious intention about performing the detection in the case of meditators or not doing it in the case of non-meditating subject persons?

In the case of net experiment situation becomes even more problematic. One can imagine that also in this case the intention of experimenter could induce the detection - at least if experimenter is near to the system. Should experimenters have spent the period of experiments in Mars or at least in a distant holiday resort! Experimenters studying remote mental interactions are usually not rich people and presumably they did not do this.

The experimenter effect is well-known in parapsychology. Some experimenters are extremely successful. Could one think that they have strong intentional powers? Ironically, this would demonstrate the reality of paranormal effects of this kind but in a way that can never convince the skeptics. There is evidence for this kind of effect in the testing of new medicines. Good results are obtained when the testers are enthusiastic and dream of a positive result. When they do same tests after some years, the results are worse.

### TGD based model

The challenge is to understand how the  $S$  imagining a measurement telling that photon went through either slit could realize this intention. What does the detection mean and what it demands?

1. The measurement should involve a state function reduction selecting between the slits entangled with observer. In principle it is enough to have an interaction of photon in either slit localizing the path of the photon to that slit. It is enough that photon interacts with charged particles in either slit with some probability. This measurement is of course not optimal since the interference diagram is only partially changed. Only some fraction of these measurements take place and produce single slit pattern so that the observed pattern is a weighted average of double slit and single slit patterns. In principle one can estimate the probability for single slit pattern from the data.

2. Quantum classical correspondence requires that in order that the intention to detect could be realized, one must have a physical connection from the  $S$  to both slits or at least either of them. Also charged particles assignable to the connection should be involved to make scattering of photon possible. Also entanglement entangling detector fires/does not fire with corresponding states of some other system, say the  $S$  would be needed.

How could one realize these connections in TGD?

1. In TGD framework the magnetic flux tubes serve as correlates of entanglement and directed attention [K55]. To direct attention to a system means to connect with it by flux tubes. Flux tubes carry dark charged particles essential for TGD view about quantum biology.
2. Every system has U-shaped flux tubes emanating from it and acting as kind of tentacles scanning the environment. As a U-shaped flux tube from system A encounters another similar flux tube from system B, a reconnection takes place if the quantized fluxes are same. The outcome is a pair of flux tubes connecting A and B. The flux tube pair can carry Cooper pairs with members of the pair at the flux tubes. The photons from laser could scatter from the charged particles.
3. The dark particles the flux tube are dark with  $h_{eff}/h = n$  [?, K66] satisfying an additional condition implying that  $n$  is proportional to the mass of the charged particle in turn implying that cyclotron energies  $E_c = \hbar_{eff}eB/m$  are universal and assumed to correspond to biophoton energies in the range of visible and UV: bio-photons would result in the phase transition transforming dark photons to ordinary photons.

In order that photon scatters from the charged particles it must have the same value of  $h_{eff}$  as the particles at magnetic flux tubes emanating from the  $S$ . Some fraction of laser photons could satisfy this condition. Note that if perturbative quantum theory applies, the classical predictions are same as lowest order quantum predictions so that  $h_{eff}$  makes it visible only in higher orders assuming that perturbation theory works when  $h_{eff}/h = n$  holds true. Unfortunately, it is not possible to estimate the probability that photon enters to the flux tube. Note that the probability depends also on the density of the flux tubes.

The effect is reported in net experiments for which distances can be long and there is no visual contact. Can one understand this?

1. If there quantum entanglement between A and B already exists one can increase the distance without spoiling the entanglement. But how to achieve the entanglement if the systems are at large distance from beginning?
2. The length of the magnetic flux tubes is not a problem. The size scale for the layers of magnetic flux tube corresponding to EEG frequency 7.8 Hz is circumference of Earth. The condition that the size of the flux tube is at least of the order of the cyclotron wavelength  $\lambda$  for cyclotron photons at the flux tube implies that length of the flux tube is of the order of the size scale of Earth for EEG frequencies.

In fact, our MBs could have much larger layers if biological rhythms have cyclotron frequencies as counterparts. The size scales could be of order light-life-time or even longer. This changes totally the view about the role of length scales in biology and consciousness. There is some evidence that galactic day defines the natural rhythm for precognitive phenomena: precognitive phenomena tend to occur at galactic midday. Galactic cyclotron frequencies (the galactic magnetic field is of order nT) could correspond to bio-rhythms up to 12 hours.

In net experiment the problem is how to generate the connection to a correct target. The same problem is encountered in the attempts to explain the claimed results of remote viewing experiments. Could the density of flux tubes of personal magnetic body (MB) be so high that the connection is generated with high enough probability.  $S$  receives data through the web. Could this help to build the desired connection.

1. Sceptic would explain the reported positive result in web experiments by saying that the results were actually induced by the intention of the experimenter who was near to the system. This might of course be the case.

2. The first possibility is that an entanglement is generated between the camera monitoring the system and slits involving flux tubes. The communication of the image from the camera to computer builds another flux tube bridge. The radiation reflected in satellite to the computer at Earth involves propagation along flux tubes. At the receiver ends similar bridges are build. There is therefore a flux tube connection with the computer of used by  $S$ , who generates the last piece of the connection. This kind of flux tube connection would be between all communicating systems. Also the experiments would belong to this entanglement network.
3. MB has layers with size scale of order Earth size. Could it be able to meet the challenge by using the information coming from web. Could the U-shaped flux tubes be so dense as to be able to build a contact with the experimental arrangement with high enough probability? If they are to represent Maxwellian magnetic field in good approximation, they should be dense. What is important that these flux tubes correspond do different space-time sheets for distinct observers: this is actually the basic distinction between the field concepts of Maxwell and TGD.

Could it be that the feedback from  $S$  at her computer via the net to the computer at the other end generates quantum correlated events and this correlation has as correlates magnetic flux tubes connecting the distant systems.

4. The hyper-imaginative option is that  $S$  can delegate the problem with collective consciousness assignable to the magnetosphere of Earth and having all the engineering knowledge that Earth has! Could we be neurons of a gigantic brain of Mother Gaia, which would help  $S$  to realize their intention. Can single neuron realize its intention on a distant neuron in brain in the similar manner? Could some kind of resonance mechanism be involved?

## Chapter 5

# How to test TGD based vision about living matter and remote mental interactions?

### 5.1 Introduction

The proposed theory of living systems and remote mental interactions involves a large number of general ideas which represent something new and one should be able to invent tests. Since the basic mechanisms of remote mental interactions are same as those of TGD inspired model of living matter, there is no special reason to restrict the tests to remote mental interactions. The emphasis is on new physics predicted by TGD. The following is an attempt to list the most important ideas and imagine possible tests. Most tests are tests of the proposed new physics suggested to be crucial for living matter. I do not possess the required background to propose any detailed experimental protocols and my hope is that I would be able to represent the basic ideas so clearly that others could invent way to test them.

Chi (life energy) and Yin (intent) provide a good example about what is involved. Usually one just tries to find correlates chi and intent by using various kinds of detectors [J63]. The detector for a given speculative effect could be physical detector measuring fields, particle currents etc., chemical methods could be used to detect the effects, biological materials and even human body could serve as a detector. If one takes TGD seriously, one can reduce the test for chi and intent to a tests for its new physics correlates. The general vision also suggests optimal choices of targets of remote mental interactions.

While preparing this chapter I learned about two articles providing reviews about empirical testing of notions of chi and intent. The first article by Kevin Chen - titled *An analytic review of studies on measuring effects of external Qi in China* [J63] - summarizes the various methods of measuring external Chi (EQ). Second article is by Lian Sidorov and Kevin Chen and titled *Biophysical Mechanisms of Genetic Regulation: Is There a Link to Mind-Body Healing?* [J82]. The main message of the article is that intent has a direct effect on DNA and that electromagnetic fields play an important role in both communication and energy metabolism. It would be interesting to combine existing general ideas with the experimental input discussed in these articles.

The appendix of the book gives a summary about basic concepts of TGD with illustrations. Pdf representation of same files serving as a kind of glossary can be found at <http://tgdtheory.fi/tgdglossary.pdf> [L15].

### 5.2 Zero Energy Ontology

Zero energy ontology (ZEO) is one of the cornerstones of TGD and has become part of TGD during last six years. Zero energy states are identified as superpositions of pairs of positive and negative energy states assigned with the future and past boundaries of causal diamonds (CDs) and correspond in ordinary ontology to physical events with positive and negative energy parts

of the state identified as counterparts for the initial and final states of the event. Effective 2-dimensionality allows a further reduction to the level of partonic 2-surfaces: also their 4-D tangent space data matter. Symmetry considerations lead to a beautiful view about generalizations S-matrix to U-matrix in terms of orthogonal basis of M-matrices, which in turn are expressible as products of hermitian square root of density matrices and unitary S-matrix [K57]. One can say that quantum theory is “complex” square root of thermodynamics.

Therefore one should try to find tests for ZEO.

### 5.2.1 The Hierarchy Of CDs

The basic assumption is that the sizes of CDs come as integer multiples of  $CP_2$  scale  $R$  and for prime multiples of  $R$  correspond to secondary p-adic length scales  $L_{p,2} = L_{p,1}\sqrt{p}$ ,  $L_{p,1} = R\sqrt{p}$ , where  $R$  denotes  $CP_2$  scale. For electron with  $p = M_{127} = 2^{127} - 1$  one has  $T_{p,2} = .1$  seconds and defines a fundamental bio-rhythm. This time scale should have preferred role in physics. More generally the secondary p-adic time scales assignable to elementary particles should define time scales relevant to macroscopic physics. The corresponding size scale can be assigned to the magnetic body of the elementary particle. Also it should be possible to assign to quark mass scales special biological time scales as has been indeed done [K8]. h predictions could be tested.

### 5.2.2 Generalization Of Standard Conservation Laws In ZEO

ZEO together with sub-manifold geometry provides a new view about conservation laws and resolves the problem posed by the fact that gravitational interactions do not seem to respect energy conservation in cosmological time scales. Conservation laws holds true only in the scale associated with given CD, not universally (this would allow only single infinitely large CD).

Superconducting coherent states involve quantum superposition of states with different numbers of Cooper pairs and therefore break the super-selection rule associated with fermion number in ordinary ontology. In ZEO they could be understood without giving up the superselection rule associated with fermion number.

Experimental tests should try to prove that quantum number conservation is a length scale dependent notion. For instance, creation of matter from vacuum is possible in ZEO, and one might hope that its occurrence could be in some scale for CDs artificially.

### 5.2.3 Breaking Of Second Law In Standard Form

In standard physics second law states that all systems are entropic but a system can reduce its entropy by feeding its entropy to the environment. Negentropic entanglement carries genuine information and life can be seen as islands of negentropy in the sea of entropy. This forces to generalized second law. The proposed generalization (see <http://tinyurl.com/ybg8qypx>) [L9] [K52] can be characterized as maximally pessimistic.

The generation of negentropic entanglement is assumed to be accompanied by generation of compensating entropic entanglement. The modified form of second law is suggested by the mechanism of directed attention based on negentropic entanglement assignable to magnetic flux tube connecting selfandtarget. Negentropic entanglement prevails during the attention but disappears after state function reduction giving rise to entropy at the level of ensemble. Second law would hold true above time scale assignable to the duration of negentropic entanglement.

There are also other reasons to reconsider second law. The breaking of second law in standard form since the arrow of geometric time can change locally. Living systems are indeed accompanied by syntropic effects as realized by Italian quantum physicist Fantappie [J64, J86]. These effects could be understood as entropic effects but with a reversed arrow of geometric time. The mechanism would be based on negative energy signals. Phase conjugate laser waves are known to obey second law in reversed direction of geometric time. Cooling effects due to the absorption of negative energy signals inducing the breaking of the standard form of the second law are predicted to be possible. One can also imagine a spontaneous excitation of atoms generating radiation in the return to ground state in a situation when there is a target able to receive negative energy signals emitted in spontaneous excitation.



Standard form of second law assumes that quantum coherence is absent in the scales in which it is applied. Both the hierarchy of Planck constants and negentropic entanglement however make possible macroscopic quantum coherence characterized by the scale involved and the natural guess is that the time scale associated with causal diamond in question defines the scale above which one can expect second law to hold. There is evidence for the breaking of second law in time scale of 1 seconds [D6].

### 5.2.4 Negative Energy Signals

Zero energy ontology allows to assign to zero energy states an arrow of time naturally since one can require that states have well defined single particle quantum numbers at either upper or lower boundary of CD. Also the spontaneous change of the arrow of geometric time is possible. The simplest possible description for U-process is that U-matrix relates to each other these two kinds of states and state function reductions can occur at upper and lower boundaries of CD meaning reduction to single particle states with well defined quantum numbers. The precise correlates for the generation of geometric arrow of time are not completely understood.

Negative energy signals to geometric past would serve as counterparts for time reversed states in the case of radiation and phase conjugate laser waves are natural counterparts for them. The signal property requires a dissipative process proceeding in preferred time direction and this kind of process has been assigned to sub-CDs and should proceed as state function reduction sequence in preferred direction of time determined by the quantum arrow of time for the zero energy state. This process would be essential for the experience of flow of time in preferred direction and for generation of arrow of geometric time as explain in previous chapter and also in [K6]. For phase conjugate laser beams the reversed time direction for dissipation is observed.

Negative energy signals make possible remote metabolism as sucking of energy from remote energy source provided resonance conditions for transitions are satisfied. The counterpart of population inverted laser could serve as ideal source and the negative energy signal could serve as a control switch inducing phase transition like process taking the excited atom like systems to ground state (induce emission). This process should occur in living matter. Anomalous excitation of atomic state by absorbing energy by remote metabolism and subsequent generation of radiation could also serve as a signature. It could also lead to cooling effects breaking second law.

Negative energy signals would also make possible realization of intentional action by initiating the activity already in geometric past. This would be very desirable in rapidly changing circumstances. The time anomalies of Libet for active aspect of consciousness could be interpreted in terms of time mirror mechanism [J19] and further experiments in longer time scales might be perhaps carried out.

Negative energy signals could be also essential for the mechanism of long term memory. They would induce a breakdown for a system analogous to population reversed laser via induced emission meaning generation of strong positive energy signal [K78].

## 5.3 P-Adic Physics

### 5.3.1 P-Adic Length Scale Hypothesis And Mersenne Hypothesis In Living Matter

p-Adic length scale hypothesis states that favored primary p-adic length scales proportional to square root of p-adic prime correspond to primes which are near powers of two:  $p \simeq 2^k$ . Favored secondary p-adic length scales would correspond to favored CD sizes coming as octaves. Mersenne primes are in special position. This leads to rather specific predictions in the case of living matter since the length scale from 10 nm to 5  $\mu$ m contains as many as four electron Compton scales  $L_e(k) = \sqrt{5}L(k)$  characterized by Gaussian Mersennes, which correspond to ordinary primes with  $k = 151, 157, 163, 167$ . This can be seen as a mathematical miracle and it is interesting that it associated with the biologically most interesting length scale range. This leads to Mersenne hypothesis [K8] stating that in living matter the p-adic length scales associated with both ordinary and Gaussian Mersennes are important. Besides this the hypothesis states that those values of Planck constant come as proportional to

$$r = 2^{k_i - k_j} ,$$

where  $k_i$  and  $k_j$  are primes characterizing two Mersenne primes. This predicts a large number of preferred time and length scales which might be relevant in living matter. Also this hypothesis could be tested.

### 5.3.2 Negentropic Entanglement

Negentropic entanglement is suggested to be a basic characteristic of living matter whereas the hierarchy of Planck constants would make possible macroscopic quantum coherence. Negentropic entanglement (see **Fig.** <http://tgdtheory.fi/appfigures/cat.jpg> or **Fig. ??** in the appendix of this book) and dark matter hierarchy allow to circumvent the basic objection against viability of computation: even technological applications can be dreamed of. At this moment the only support comes from proposed applications to particle physics and from the modelling of living matter and is only indirect. The basic challenge is to learn whether Nature has chosen negentropic entanglement and hierarchy of Planck constants as its tools. The next challenge would be to develop technological tools for handling them.

For instance, phase transitions changing Planck constant from ordinary to larger one would effectively mean disappearance of ordinary matter and this could serve as a signature. Negentropic entanglement makes possible abnormally long duration of entangled period resembling that appearing in Orch Or of Hameroff and Penrose [J54] and anomalously low dissipation could serve as a signature of both negentropic entanglement and of hierarchy of Planck constants.

Negentropic entanglement could be associated with many-particle states at magnetic flux tubes. Either non-local single particle excitations of Bose-Einstein condensates of bosonic states (Cooper pairs of electrons say) or many-fermion states can be considered [K70]. Metabolic energy quantum liberated in  $\text{ATP} \rightarrow \text{ADP}$  would generate the excitation. NMP does not tell whether a transfer of negentropic entanglement from high energy phosphate bond to flux tube takes place or whether the negentropic entanglement is created in the process. Exactly the same process would take place in photosynthesis as a first step and there is evidence for non-local excitations of electrons [I9]. Whether electrons or their Cooper pairs are in question will be known probably very soon. The general prediction is that metabolic energy transfer always takes place via a transfer of dark photon. The decays of these photons to ordinary photons should produce bio-photons with energy around 5 eV and IR photons with this energy could have biological effects.

### 5.3.3 Shnoll Effect As Evidence For P-Adic Physics?

In Shnoll effect [E3] the expected probability distribution with single peak develops several peaks and the effect depends on periods assignable to solar system. The effect is very general and appears even for atomic nuclei. There exists no standard physics explanation for it.

1. The TGD inspired model of Shnoll effect [K5] as a statistical effect is based on the interpretation of probability distribution having integer valued argument as p-adic valued distribution and the replacement of the parameters and variables with their images under canonical identification. For electron the magnetic body has size scale of the Earth so that this effect should be mediated by the magnetic body assignable to the CD and could be seen as evidence for these notions.
2. The oscillatory character of the effect with periodicities assignable to solar system inspires the question whether the transformation of intention to action mediated by canonical identification might be involved. If so this mechanism would apply also to experimental situations involving effect of intent on both living and inanimate systems. The prediction is the appearance of characteristic number theoretical signatures in the form of probability distributions. It has however turned out that the idea about p-adic-real phase transitions is not mathematically sound.

## 5.4 Magnetic Body As Carrier Of Dark Matter

Magnetic body carrying dark matter is certainly a central concept.

### 5.4.1 Dark Matter As A Hierarchy Of Phases With Large Value Of Planck Constant

1. Dark matter is identified as a hierarchy of phases with effective value of Planck constant coming as a multiple of ordinary Planck constant. A more stringent hypothesis inspired by spin glass degeneracy is that given multiple of Planck constant correspond to an effective local singular covering of the embedding space. In biological systems the values of Planck constant could be rather larger: the condition that a photons with given frequency correspond to energies above thermal energy at physiological temperatures allows to estimate  $\hbar$  as ratio of thermal energy with the photon energy for ordinary value of  $\hbar$ . This dark matter must be distinguished from galactic dark matter (which could be actually magnetic energy) assignable to long flux tubes like structures around which galaxies concentrate like pearls in necklace. The values of Planck constant proposed for flux tubes mediating gravitational interaction between bodies with masses  $M$  and  $m$  is gigantic:  $\hbar > GMm/c$  and can be assigned to dark energy rather than to dark matter.

It is assumed that at partonic 2-surfaces the sheets of multiple covering become completely degenerate and partially degenerate at two kinds of preferred 3-surfaces.  $n_1$ -fold branching occurs both at space-like ends fo space-time surface assignable to CD boundaries and  $n_2$ -fold branching at light-like orbits of wormhole throats at which induced metric changes its signature. At partonic 2-surfaces branching to  $n_1 n_2$  surfaces occurs. There is mathematical analogy between 3-surfaces and partonic 2-surfaces with 2-branes which are also obtained as piles of copies of surfaces which degenerate to single one. Now the degeneration of 3-branes would occur only at the 3-D boundary of the brane.

2. Living matter would be ordinary matter controlled by dark matter at magnetic flux quanta assignable to living system. Magnetic body would have onion-like layered structure. For instance photons with energies in EEG range would correspond to parts of magnetic body with the scale of wavelength which is now of the order of Earth radius.

Tests for the presence of dark matter.

1. The basic prediction is the existence of scaled versions of standard model physics. Particles with large Planck constant would have same masses as ordinary ones but scaled up Compton wave lengths would make gossible macroscopic quantum phases in much lower densities as usually. The proposal is that living matter involves scaled variants of electroweak physics and hadron physics. Also p-adically scaled variants with scale mass spectrum can be considered and resonant interactions between members of the two fractal hierarchies are natural when the scales co-incide.
  - (a) The scaled variant of QCD like physics is needed if color qualia are due to quark color. This is achieved by coding A, T, C, G to spin states of  $u$  quark pairs assignable to flux tube pairs in the model of DNA as TQC. Findings of mathematician Barbara Shipman [A4] suggests that the mathematics of colored quarks are involved with the honeybee dance via so called flag manifold  $SU(3)/U(1) \times U(1)$  parametrizing different choices of color quantization axis. Could the presence of dark  $u$  quarks at the ends of flux tubes attach to DNA and lipid layers be tested? For instance, could it be detect the presence of quark charge equal to  $2/3$ ?
  - (b) The prediction would be that at space-time sheets corresponding to given value of Planck constant long ranged color and/or electroweak interactions are present meaning the presence of new long range forces. Could these be partially responsible for the coherence of living matter: could color confinement play an essential role? Elementary particles are pairs of magnetic monopoles separated by Compton length: could also second monopole containing only neutrino pair be made visible by a suitable experimental arrangement?

Maybe even ordinary condensed matter physics could involve  $Z^0$  force below atomic length scale [K30].

2. One motivation for the hierarchy of Planck constants was the evidence that water behave as  $H_{1.5}O$  in atto-second scale. The explanation was that 1/4 of hydrogen nuclei (protons) are dark. Could these experiments be carried out in other time scales and living matter? I have proposed that the rich anomaly spectrum of water above freezing point could be understood if it is a multiphase system containing also dark components [K30]. Could one test this hypothesis by concrete model building and comparison with experimental facts?
3. Dark nucleons correspond to the states of DNA, RNA, tRNA, and amino-acids and vertebrate code has simple realization for dark nucleons. Could one prove experimentally the existence of dark nucleons? Perhaps as a dark plasma like phase?
4. Quantum coherence in unexpectedly long scales is predicted to be possible for dark matter. For instance, super-conductivity at temperatures at which it should not exist, becomes possible [K14, K15, K71, K72]. I have proposed a model of high  $T_c$  superconductivity and also its biological variant based on electron pairs with large Planck constant and Compton length of order cell membrane thickness. Josephson current through cell membrane is one testable prediction. EEG would be partially determined by these Josephson currents. It is now known that photosynthesis involves macroscopic quantum coherence in unexpectedly long length scale. The model is in terms of large  $\hbar$  electron Cooper pairs. Also this model should be testable.
5. With inspiration coming from the model of quantal effects for ELF photons on vertebrate brain, EEG photons are identified as dark photons and bio-photons as their decay products [K8]. This identification predicts that the energies of these photons are in visible and UV range. Could it be possible to see the emission of dark EEG photons with these energies in metabolic book keeping?

### 5.4.2 Tests For The Notion Of Magnetic Body

What kind of tests can one imagine for the notion of magnetic body?

1. The existence of magnetic bodies.
  - (a) Could one photograph dark matter at magnetic bodies? The mechanism would be transformation of ordinary photons to dark photons scattering from dark charged particles and transformation back to ordinary photons. Peter Gariaev might have already done this [K1]. This kinds of experiments might be continued and refined.
  - (b) How the existence of magnetic flux tubes connecting two objects - say living organisms - could be tested? What happens to flux tubes when the cells of living organism are taken far away from the organism. The experiments of Cleve Backster (see <http://tinyurl.com/43wbd6>), who introduced the notion of primary perception in the study of electrical reactions of plant which was harmed or threatened to be harmed suggest that this connection continues. Do the flux tubes remain intact and imply correlations between the distant cells and organism or - in the case that they are loops - are they split by reconnection mechanism? Could the flow of biologically important ions occur between the ends of flux tubes (it could also be that only electrons and protons and perhaps some dark nuclei - even quarks participate the flow). Could one use markers for the ions to test the existence of this kind of flows.
  - (c) How to measure the presence of the flux quanta of magnetic fields of magnetic bodies via the interaction of ordinary matter with classical electromagnetic fields created by dark particles? The description of this interaction (see <http://tinyurl.com/y9exp84r>) is in terms of topological condensation to multiple space-time sheets [K96]. Now embedding space effective covering and space-time has sheets analogous to those of Riemann surface of function  $z^{1/n}$ . This multi-sheetedness does not correspond to ordinary many-sheetedness. If all physics reduces to that associated with partonic 2-surfaces then

classical fields carrying different values of Planck constant should interact since different sheets co-incide at partonic 2-surfaces. The (effective) value of Planck constant defined as the number of sheets of covering can depend on the region of 3-surface. Are there rules governing this change?

- (d) Could one demonstrate the presence of magnetic monopoles at flux tube ends? Even elementary particles should possess magnetic body with largest flux tubes having length scale defined by the p-adic secondary p-adic length scale characterizing particle and characterizing the size scale of CD assignable to elementary particle. Also smaller layers of magnetic body should be present: in particular that corresponding to the primary p-adic length scale of order Compton length. Secondary p-adic length scale corresponds to a time scale of .1 seconds for electron, the fundamental biorhythm. Could one identify bio-rhythms assignable to quarks which are more massive than electron. The QCD estimates for u and d quark masses are about 5 MeV and 20 MeV and this gives an idea about secondary p-adic time scale which should be a negative octave of .1 seconds. 12.5 ms (80 Hz) and 2.5 ms (400 Hz) are the estimates for the secondary p-adic time scales.
- (e) Magnetic body having fractal onion-like structure would play a key role neuroscience. The effects of ELF em fields on vertebrate brain at multiples of cyclotron frequencies were the original motivations for introducing the hierarchy of Planck constants. EEG would serve as communication and control tool in the system defined by magnetic body and biological body. EEG frequencies should correspond to linear combinations of harmonics of Josephson frequency for cell membrane as electronic (at least) superconductor and harmonics of cyclotron frequencies for dark ions. This leads to a rich spectrum of quantitative predictions about EEG spectrum and attempts have been made to understand the dependence of EEG spectrum on state of consciousness. For Calcium ion the cyclotron frequency is 15 Hz.
- (f) Also magnetic body has dynamics - highest layers of body can disappear or reappear or completely new layer can emerge- and one can ask whether this dynamics could be experienced directly. The effects induced by Persinger's God helmet [?]ould have interpretation in terms of dynamics of magnetic body. Also OBEs could be understood as effects related directly to magnetic body [K95]. One can also ask whether astrophysical phenomena could effect directly the magnetic bodies and therefore conscious experiences. Effects of solar storms and auroras represent basic examples of this kind of effects. Maybe this could be tested?

## 2. The dynamics of flux tubes.

- (a) Phase transitions changing Planck constant would induce shrinking of magnetic flux tubes. These could correspond to volume changing transitions of gel phase in living matter. Bio-catalysis would rely on these phases transitions and they would allow bio-molecules in the dense soup of bio-molecules to find each other [K8].
- (b) Reconnection of magnetic bodies second fundamental dynamical process playing key role in living matter.  $ATP \leftrightarrow ADP$  process would be involved with reconnection. ATP as a molecule of consciousness would accompany negentropic entanglement. Information molecules attaching to receptors would represent ends of flux tubes attaching to receptors and forming longer connected flux tubes. This would be basically generation of qualia in the length scale defined by the distance of the cell sending the information molecule and the cell receiving it. Remote sensory perception would rely on the same mechanism. One should be able to test the hypothesis that the stretching of flux tubes accompanying the diffusion of information molecule from sender to target represents deeper level of the dynamics of information molecules? The transfer of dark particles along the flux tube could be one possible signature.

If it is possible to demonstrate the existence of magnetic flux tubes by studying the flow of dark particles between two systems, one could try to test whether changes in the flow pattern by reconnection could become manifest via the flows.

- (c) Also remote mental interactions should involve generation of flux tubes between the biological and magnetic bodies of the target and operator and reconnection for loops

could be the mechanism. Quantization of magnetic flux is necessary for this mechanism to work. Particle flows between target and operator would be one signature. For living target the coherence of counterparts of EEG would be second signature.

### 5.4.3 Bio-Superconductivity

#### TGD inspired model of high $T_c$ superconductivity

TGD inspired view about high  $T_c$  electronic superconductivity and its biological counterparts are discussed in [K14, K15, K71, K72]. Also the TGD inspired model for ordinary high  $T_c$  electronic super-conductivity relies on flux tubes assigned with stripes found to serve as kind of highways carrying supra currents. High  $T_c$  super-conductivity involves two critical temperatures:  $T_c$  and  $T_{c_1}$ . Below the higher critical temperature  $T_{c_1}$  Cooper pairs with large Planck constant are assumed to be present but magnetic flux tubes are assumed to be rather short and closed (the phase is antiferromagnetic) so that macroscopic supra currents cannot flow. Around the lower critical temperature  $T_c$  flux tubes fluctuate and form by reconnection longer flux tubes and percolation type process giving rise to macroscopic supra currents becomes possible. By p-adic length scale hypothesis the basic dimensional parameters could correspond to cell membrane thickness (10 nm) and cell nucleus length scale ( $2.5 \mu\text{m}$ ) even for ordinary high  $T_c$  super-conductivity.

An analogous mechanism is expected to be at work for cellular system and give rise to electronic supra current. Also biologically important bosonic ions should give rise to cyclotron Bose-Einstein condensates with large value of Planck constant. In the case of fermionic ions Cooper pairs would be required. Another possibility is formation of exotic ions when some neutral color bonds between nucleons in nuclear strings become charged. The energy change should be relatively small- of order keV- and there is evidence for this kind of states: nuclear reaction rates vary with a period of year explainable in terms of the variation of the distance from the Sun effecting also the intensity of X ray radiation from Sun.

#### Leakage of supra currents as basic mechanism

The basic element of the proposed vision is remotely induced leakage of supra currents from magnetic flux tubes to atomic space-time sheets. This same mechanism works for both endogenous biological self-organization and remote mental interactions which would form a standard element in the construction of our sensory representations. The most economic experimental strategy would be a direct verification of this basic mechanism.

An especially dramatic effect would be the appearance of ions from magnetic flux tubes to the target of remote mental interaction not present in the target initially. Sue Benford has found evidence for the appearance of S, Mg, and Al in X ray films which were exposed to the radiation coming from so called torsion generator [I32]. Intentional effort was involved with the experiment. What happened was that dots and tracks with typical size scale of one millimeter appeared in the X ray film. The dots and tracks did not allow identification as tracks of charged particles, and the exposed regions contained S, Mg and Al not present elsewhere. The leakage of energetic super-conducting ions to atomic space-time sheets dissipating their energy by emitting electromagnetic radiation and ionizing the atoms is the natural explanation for the effect [I32, I13]. Note that both X ray films and nuclear emulsions contain gelatin which is an organic compound and might increase the sensitivity of the system.

#### Time reversal for the leakage of supra currents

The time reversal of the mechanism generating the leakage of supra currents could be especially important for healing. This mechanism is consistent with the presence of remote bound state entanglement and anomalous production of metabolic energy when binding energy is liberated.

The mechanism would be accompanied by a mysterious disappearance of marker ions in the tissue, and manifest as time reversed function of various molecular machines certainly detectable. Phase conjugates of (that is time reversed) microwaves at critical frequencies could induce the healing process. For instance, de-differentiation of cells might be induced in this manner.

As explained earlier, geometric time reversal could typically involve generation of anomalous radiation by excitation of atoms or molecules by emission of negative energy photons. Rotating

magnetic systems (Searl machine) would be especially interesting for proving that time reversal indeed occurs. One could try to demonstrate that biological rhythms correspond to dissipation-healing cycles (wake-up sleep period and metabolic cycles being basic examples).

#### 5.4.4 Direct Supra Currents Along Magnetic Flux Tubes

Direct supra currents along magnetic flux tubes are also predicted besides Josephson currents. Direct supra currents would be excellent candidates for the currents of Becker (see <http://tinyurl.com/ybnjk9bq>) [L12]. This model assumes that living matter is a semiconductor having underlying regular liquid crystal like structure.

The lipid layers of cell membranes are indeed liquid crystals and the braiding of magnetic flux tubes induced by the flows of the 2-D liquid formed by lipids is central in the model of DNA as topological quantum computer. According to Mae-Wan Ho liquid crystal patterns provide memory representations: in TGD one would achieve the same by the storage of liquid crystal flow patterns to the braidings of flux tubes. For the direct quantum currents the assumption of actual semiconductor structure might be un-necessarily strong.

Magnetic flux tubes can also carry longitudinal electric field and one can construct a simple model for the quantum states of charged particles in this kind of electric field. Large value of Planck constant is natural for long flux tubes. Flux tubes could have size scale of body or of even magnetic body. The model provides unexpected insights about character of quantal currents, allows to understand the amplitude windows for the effects of ELF em fields on vertebrate brain, the effective semiconductor property of living matter, and the effect of needles in acupuncture as metabolic effect. Disease as a loss of negentropic entanglement, healing as a regeneration of negentropic entanglement, the association of negentropic entanglement with ATP and high energy phosphate bond perhaps assignable to a Cooper pair like state, vacuum zero point kinetic energies as fundamental metabolic quanta, and loading of metabolic energy batteries by acceleration of charged particles in electric field so that they can be kicked to smaller space-time sheets are the basic of the model (it is essential that the currents are non-ohmic!). The challenge is to test the model for DC currents and the models of healing and acupuncture.

The model also proposes that the interaction of radiation fields is based on acceleration of charged particles on flux tubes having also topological sum contacts to “massless extremals” representing space-time correlate for radiation fields. The optimal situation is achieved when the electric field of ME is parallel or antiparallel to flux tube and ME therefore orthogonal to it. If the flux tube is near critical voltage for the generation of quantal DC current, the perturbation caused by the radiation field can be induced by the quantal DC current accelerating charged particles and loading metabolic batteries by kicking them to smaller space-time sheets. This would directly correspond to the generation of ATP responsible for negentropic entanglement and generating eventually liberating metabolic energy. The killer prediction is that the biological effects are caused only at the second half of the cycle. In the case of EEG theta waves there is indeed evidence for this [J91].

## 5.5 TGD View About Consciousness And Biology

In the following TGD based view about consciousness and biology is summarized with emphasis on mechanisms. Proposals for tests are made when possible.

### 5.5.1 The Notion Of Conscious Hologram

Living system as conscious hologram is a metaphor emphasizing the fractal structure of sensor and cognitive representations. The model to be discussed relies heavily on the notion of magnetic flux tube and negentropic entanglement.

#### Attention

What is attention? What are its characteristic properties? What could be the quantum physical correlate for it. The naïve view western view is that attention and perception is directed: there

is observer and observed. The “Eastern” view says that observer and observed are one and same thing and this distinction applies only to memory about attention.

The proposed identification for the correlate of attention as negentropic entanglement (see **Fig. <http://tgdtheory.fi/appfigures/cat.jpg>** or **Fig. ??** in the appendix of this book) having as space-time correlates magnetic flux tubes corresponds to the “Eastern” view: I have made also an attempt to explain how asymmetry between perceiver and perceived could emerge [K3]. Directing attention to an object of external world means formation of flux tubes connecting perceiver to the object. Qualia prevail as long as this attention continues. There is a resemblance with Orch Or of Hameroff and Penrose [J54] and with active information of Bohm [J58]: attention is the activity.

This view about attention means that ordinary sensory perception is a non-local process involving in an essential manner also the target.

The test would be finding whether (for instance) visual attention implies “intentional imprinting” in the object of attention. This relates directly also to the proposed mechanism of remote mental interactions. In the case of hearing our ability to tell whether the sound comes from external world or not is a mystery if one believes that qualia are product of some neural activity. The flux tube model would assign also to hearing flux tubes which are attached to some object oscillating with the sound wave, even molecules of air. How it is possible to identify the sound source “correctly” if anything that oscillates with sound wave can serve as target of attention? The natural definition of source is in terms of intensity maximum. Both ears are needed to identify the direction of maximum intensity.

### Model for qualia

Directed attention involves qualia. The qualia correspond to quantum number increments during the process leading from ZEO counterpart of initial prepared state to the final entangled states (identified as states at lower and upper boundaries of CD). State function reduction which eventually happens reduces the negentropic entanglement at the upper end of CD and after this there is possibly a memory of qualia, not genuine qualia anymore. Flux tubes connecting observer and observed are the correlates for the sensory perception and generation of qualia. This leads to sensory capacitor model in which the analog of dielectric breakdown amplifies the polarization between the ends of flux tubes. Besides this the process involves scaling up the lengths of the sensory capacitor flux tubes: perhaps by a phase transition increasing the value of Planck constant.

Various electrets and strong electric fields characterizing biomatter could relate to sensory perception at molecular and cellular level. Cell membrane could give rise to sensory perception of external world during nerve pulse which indeed involves dielectric breakdown. One might hope of finding at test for the generation of polarization in longer length scale during generation of qualia.

### Fractality of sensory percepts and EEGs

The model of qualia suggests fractal sensory percepts. Sensory perception would be a process propagating from long to short length scales and generating qualia transforming to memories about qualia. Cell membranes and DNA could be end points of this process and lipids of the cell membrane liquid crystal would form pixels for a representation of external world analogous to that provided by computer monitor. In case of ordinary cells this representation would be about chemical environment, in the case of neurons about the external world. How this representations relates to our conscious experience?

It might be that negentropic entanglement in the scale of magnetic body is involved so that the process generating qualia begins from the level of magnetic body and proceeds downwards.

EEGs consisting of dark large  $\hbar$  photons with energies in visible and UV range are used to communicate sensory data to magnetic body as Josephson radiation from cell membranes with frequencies characterized by the value of Planck constant. The radiation would propagate along flux tubes and flux sheets. What is the precise meaning of this communication? Is it communication of symbolic representation constructed by brain and therefore communication of memories?

The fractal onion-like structure of magnetic body requires fractal hierarchy of analogs of EEG which could be called XYGs. Even weak bosons and gluons could give rise to the analog of EEG in appropriate length scales if dark matter hierarchy is realized. Biophotons are tentatively



identified as decay products of large  $\hbar$  EEG photons and their scaled variants. Could this be tested somehow?

Fractality of memory representations would mean that scaled down “stories” lasting much shorter time than the real episode are formed and could be formed as several copies. This could be one of the key elements of intelligent behavior. There is evidence for this has been found by Yamaguchi *et al* [J91, J90] in the case of theta waves. TGD based explanation in terms of phase transitions generating scaled versions of the real time representation of the event is discussed in [K3]. It might be possible to test this aspect of memory representations in terms of EEG waves as in the work of Yamaguchi.

### Fractality of sensory representations

The notion of conscious hologram means that practically any part of body can represent any other part of body or even external world. Concerning the notion of conscious hologram at the length scale of body, Kirlian imaging with simultaneous electrical stimulation of other body parts, in particular ear, is very promising manner to test the hypothesis [I42]. It is also known that ear forms kind of fractal miniature of body with respect to acupuncture points so that stimulation of particular part of ear electrically creates sensation that particular part of body is stimulated [J71].

PLR spectroscopy [I17] provides a precise and accurate manner to prove the viability of the notion of conscious hologram empirically. What is needed is the analysis of the frequency spectrum: does it really contain the predicted differences of cyclotron harmonics. If this approach and its variants really work it becomes possible to determine experimentally the densities of super-conducting ions and Cooper pairs at parallel space-time sheets.

At the level of remote mental interactions the stimulation of brain electrically could induce in other brain nerve pulse pattern or even experience correlating with the nerve pulse pattern or even experience in the stimulated brain. Even water near criticality could provide this kind of representations. In Imaging laboratory at Hilversum, Holland the following experiment has been performed with success. The experiment involves water droplet near freezing point. A person with abilities of a healer asks for Universe to express something in the structure of the droplet. What results are beautiful fractal patterns representing say plant leaves, even a picture about the laboratory’s architecture has been generated in this manner. Also the work of Emoto [I28] and work carried out in Aerospace Institute in Germany [I6]

### 5.5.2 TGD View About Metabolism

TGD view about metabolism involves two new elements. First of all, TGD leads to the idea of universal metabolic quanta. These would make possible metabolism before the development of a complex chemical machinery which also would rely on universal metabolic energy quanta. Secondly, ATP seems to have two roles as a molecule of consciousness and as a metabolic quantum? These roles are very closely related and the connection with the modification of second law of thermodynamics is suggestive.

### Many-sheeted space-time and universal metabolic energy currencies

The dropping of particle to a larger space-time sheet liberates energy which is the difference of the energies of the particle at two space-time sheets. If the interaction energy of the particle with the matter at space-time sheet can be neglected, the energy is just the difference of zero point kinetic energies. This energy depends on the details of the geometry of the space-time sheet. Assuming p-adic length scale hypothesis one obtains a general formula for the difference of zero point kinetic energies. These energy increments define ideal candidates for universal metabolic currencies and under certain additional conditions (say resonance with energies of some important molecular transitions) these currencies could be predecessors of the standard metabolic currency of order .5 eV. There is a more detailed treatment of universal metabolic currencies in [K8]. A model for how universal metabolic currency .5 eV assignal to the dropping of proton from atomic space-time sheet is discussed in [K43].

In many-sheeted space-time particles topologically condense at all space-time sheets having projection to given region of space-time so that this option makes sense only near the boundaries

of space-time sheet of a given system. Also p-adic phase transition increasing the size of the space-time sheet could take place and the liberated energy would correspond to the reduction of zero point kinetic energy. Particles could be transferred from a portion of magnetic flux tube portion to another one with different value of magnetic field and possibly also of Planck constant  $h_{eff}$  so that cyclotron energy would be liberated. In the following only the “dropping” option is discussed.

The hypothesis predicts the existence of anomalous lines in the spectrum of infrared photons. Also fractally scaled up and scaled down variants of these lines obtained by scaling by powers of 2 are predicted. The wavelength corresponding to 0.5 eV photon would be  $\lambda = 2.48 \mu\text{m}$ . These lines should be detectable both in laboratory and astrophysical systems and might even serve as a signature for a primitive metabolism. One can also consider dropping of Cooper pairs in which case zero point kinetic energy is scaled down by a factor of 1/2.

Interestingly, the spectrum of diffuse interstellar medium exhibits three poorly understood structures [I2]: Unidentified Infrared Bands (UIBs), Diffuse Interstellar Bands (DIBs) [I1], and Extended Red Emission (ERE) [I44] allowing an interpretation in terms of dropping of protons or electrons (or their Cooper pairs) to larger space-time sheets. The model also suggests the interpretation of bio-photons in terms of generalizes EREs.

It must be emphasized that the identification of metabolic energy quanta as increments of zero point kinetic energies is untested and allows variants. Magnetic flux tubes are in longitudinal degrees of freedom effectively one-dimensional boxes, and the energy increment for the longitudinal excitations could replace the increment of zero point kinetic energy in the transfer of the particle between space-time sheets. Also excitations in transversal degrees of freedom (increment of cyclotron energy) are possible. These excitation energies could define universal metabolic energy quanta. This option emerges in the model for the generation of negentropic entanglement giving also the connection with the findings about effects of ELF em fields on vertebrate brain. The model predicts that metabolic energy transfer always involves generation of dark photon absorbed by magnetic flux tube so that negentropically entanglement non-local single particle excitation is created. One expects that IR photons with energy around 0.5 eV (metabolic energy quantum) have biological effects. Also bio-photons resulting from the transformation of dark photons to ordinary photons at this energy are possible.

### Plasmoids as prebiotic life forms

A natural conjecture is that plasmoids involving charged plasma at magnetic flux quanta define prebiotic life forms [?]. The minimum prerequisites for life would be present if the proposal for universal metabolic quanta is correct. Even dark nuclei could be regarded as plasma like structures so that even genetic code and nuclear counterparts of basic biomolecules could be involved.

The model of high  $T_c$  super-conductivity and the general vision about dark matter hierarchy have led to a rather precise model for magnetic body as an intentional agent utilizing biological body or its part as motor instrument and sensory receptor [K29]. Dark matter plasmoids and plasma oscillation patterns as representations of control commands are one important aspect of the model. The prediction is that plasmoids should have been predecessors of ordinary life forms. There is laboratory evidence that plasmoids behave like life forms [I27, I22]. Very high temperatures catastrophic for ordinary life forms could prevail at magnetic flux quanta associated with plasmoids. This forces a radical reconsideration of the question how pre-biotic life have evolved and forces to ask whether even the hot interior of Earth could have served or still serve as a seat of life.

The old Expanding Earth hypothesis explains the observation made already at the time of Wegener that all continents fit to a structure covering entire Earth if the radius of Earth were one half of the recent radius. A phase transition increasing the value of Planck constant for the space-time sheet of Earth by factor two could explain this finding and leads to a rather non-trivial vision about early life at Earth (see <http://tinyurl.com/y7uuy119>) [L44].

ATP cannot serve as a correlate of negentropic entanglement during prebiotic period but this does not mean that negentropic entanglement would not be possible. One should understand why ATP makes possible negentropic entanglement. Negentropic entanglement allows states with negative binding energy which are not bound states in the usual sense. Why high energy phosphate bond would be example of this kind state? Understanding this might help to understand the conditions under which negentropic entanglement is possible. The laboratory evidence for plasmoids as prebiotic life forms [I22, I26] raises hopes that one could learn to create situations in which

negentropic entanglement prevails.

In situations in which the target is in-animate matter, universal metabolic quanta might be relevant for the realizations of remote mental interactions.

### Controlling metabolism by IR laser beams and DNA functioning by maser beams?

One could also test the “dropping” of ions to larger space-time sheets. If the dropping ions have dissipated their energy this means that system acts like a maser at wavelength defined by the reduction of the zero point kinetic energy liberated in the dropping of the ion. The pumping process would correspond to the leakage of the supra currents to atomic or some other space-time sheet, and induced emission to the dropping induced by the photons already present.

1. The effectiveness of metabolic energy production in which proton drops and absorbs a negative energy photon of energy about .5 eV could be amplified by a beam of coherent IR light “kicking” protons back to the atomic space-time sheets. The irradiation by phase conjugate beam would “steal” energy from living system by inducing the dropping without locally usable energy. Whether living systems can “steal” energy from other life-forms in this manner could be tested. The “stealing” of the metabolic energy (there is probably a fractal hierarchy of “energy currencies” )from cancer cells by phase conjugate laser light might be the first principle explanation for why Priore’s machine works.
2. The dropping of ions from say  $k = 151$  space-time sheet to larger space-time sheets creates microwaves with frequencies corresponding to zero point kinetic energies about  $2^{-15}/A$  eV,  $A$  atomic number. For electron the energy is about 1/16 eV. These processes could define exotic forms of metabolism, perhaps at the level of DNA. This process could be amplified by an external microwave beam or its phase conjugate and phase conjugate beam could induce the correction of genetic errors.

The transformation of photon energy to metabolic energy could be following. Suppose that the electric field of IR photon is parallel to the flux tube which carries an electric field and is near criticality for the generation of quantal DC currents. If the direction of polarization is correct, the additional contribution to electric field induces direct current and acceleration of electrons and protons and their transfer to smaller space-time sheets and therefore loading of metabolic batteries. This could also make generation of ATP possible.

3. The scaling law of homeopathy [I11] states that high and low frequencies accompany each other and are in a constant ratio for which TGD predicts several values determined as ratios of zero point kinetic energies and cyclotron energies at magnetic flux tubes. The scaling law can be understood as follows: dropping of ions to cyclotron states generates with the zero point kinetic energy and cyclotron photons. Low frequency photons can interact resonantly with the system for which the internal excitations have same low frequency. This generates internal excitation with wavelength which is of the order of system size and this excitation couples resonantly to photons with wavelength equal to system size: thus high frequency photons result.

Thus one might achieve the above proposed effects using also low frequency irradiation. For instance, irradiation by kHz waves in order to achieve generation of bio-photons and irradiation by ELF waves in order to achieve generation of microwave photons. In fact, I started to develop the vision about living system as a macroscopic quantum system from the finding of Blackman [J27] and other pioneers of bio-electromagnetism that ELF radiation has delicate effects in the functioning of living matter. It seems that the basic mechanism might be the dropping of ions between space-time sheets or its time reversal. This mechanism could be tested also for remote objects.

### 5.5.3 The New View About DNA

The new view about DNA and cell involves several aspects.

1. The first vision about DNA was inspired on many-sheeted space-time alone and on the idea about the role of magnetic body of DNA. There was also a proposal about hierarchy of codes

containing as a successors of genetic code memetic code assignable to Mersenne prime  $M_{127}$  characterizing electron [K39]. The codewords of this code could be represented as sequences of 21 DNA codons.

2. DNA as topological quantum computer model [K3] introduced a completely new level of information processing as counterpart of topological quantum computation made possible by magnetic flux tubes connecting DNA nucleotides and lipids of nuclear or cell membrane defining braiding. A realization of genetic code is involved. Perhaps the most convincing realization is in terms of 3+1 spin states of fermion pairs assignable to pairs of flux tubes. The realization using  $u$  quarks allows to stabilize DNA carrying 2 units of electric charge per nucleotide. The positive charge  $4/3$  at the end of flux tube pair serves as possibly testable experimental signature for the proposal. Introns would be optimal for the topological quantum computation and the increase of the intronic fraction of DNA with the increase of evolutionary level conforms with the idea that the evolution of magnetic bodies distinguishes between us and our cousins.

The notion of magnetic body inspires also the proposal that magnetic flux sheets traversing through DNA make possible integration of genomes to higher level structures: this leads to the notions of super genome and hypergenome. Could these higher level genomes manifest themselves as coherent gene expression in the scale of organism and even of population? The development of collective levels of consciousness and cultural evolution would reflect directly the presence of this level of information processing. One implication is the failure of genetic determinism. For this there already exists empirical support. Already the fact that the genomes of humans and of rather primitive life forms do not differ much (apart from intronic portion) suggests that an unidentified level of information processing is involved.

3. Dark DNA as sequences of dark nucleon strings is a fr completely unexpected twist in the development of ideas related to DNA and genetic code [K56, K40]. The theoretical challenge is to understand the relationship with ordinary DNA and its companion molecules. Is the transcription between dark nucleon counterpart of DNA, RNA, tRNA, amino-acids to their chemical variants possible? How could one make dark protons and nuclear strings “visible”. Scattering of photons from dark proton strings would involve transformation to dark photons and back. Also classical em fields created by the dark nuclei are in principle observable.

The presence of dark DNA could make possible active genetic engineering using the “virtual” world of dark DNA, and its companions and one can imagine that biology applies the analog of R&D in industry. This is obviously in conflict with the dogma that evolution is solely due to random change and selection.

4. What is amusing that the model for water memory and homeopathy led to this proposal [K40]. In the succession process water clusters would “steal” the magnetic bodies of dissolved polar ions and representations of the magnetic bodies as dark nucleon sequences would be generated. There could be also evolution driven by repeatedly occurring mechanical agitation implying increase of Planck constant associated with the magnetic bodies involved. All polar molecules have representation as a DNA sequence. The fundamental mechanism of immune system would be reconnection of magnetic flux tubes associated with the polar ions and the structures representing them so that the cyclotron radiation propagating along them could not interact with the biomolecules. Immunity would be the outcome from this “stealing of attention”. If the transcription of dark nucleon sequences to the biochemical counterparts exist this could make possible to automatically generate genes coding for proteins which in turn “catch” the polar molecules that they represent.

A fascinating possibility is the transfer of genes homeopathically. Genes would be dissolved into water and succession process could be used to induce evolution of the magnetic bodies of the dark DNA associated with genes. These could be transferred to cells and germ cells and transcription to ordinary DNA would make possible genetic engineering.

#### 5.5.4 Model Of Cell Membrane As Almost Vacuum Extremal

The model for cell membrane as almost vacuum extremals brings in additional new physics predicted by TGD. Vacuum extremals are basic solutions of field equations and their small non-vacuum

deformations are expected to be important for quantum TGD. For instance, the long length scale limit of the theory in gravitational sector is expected to rely on almost vacuum extremals. 4-D spin glass degeneracy is also due to vacuum extremals and allows to have classical space-time correlates also for the non-deterministic aspects of quantum theory as a failure on standard form of classical determinism. Vacuum degeneracy also implies the realization for the hierarchy of Planck constants in terms of effective multiple coverings of the embedding space.

Since quantum criticality is expected to be key attribute of sensory receptor, one expects that cell membrane is almost vacuum extremal. This would also imply that large values of Planck constant and dark matter are involved.

The model for cell membrane as almost vacuum extremal involves an assumption that Weinberg angle in this phase differs from its value for elementary particles, which are in many respects diametrical opposite of almost vacuum extremals. The model makes precise predictions about preferred photon energies in visible and UV range and these photon energies correspond to peak frequencies for the photoreceptors.

## 5.6 General Model For Remote Mental Interactions

The assumption that the notion of magnetic body and hierarchy of Planck constants defines key element in remote mental interactions reduces the tests at the level of physics to tests for these notions.

### 5.6.1 Direct Metabolic Correlates For Remote Mental Interactions

The proposal is that ATP is the molecule of consciousness in the sense that its presence as relay in flux tube connection carrying negative entanglement entropy. ATP would be also the molecule of attention if negentropic flux tubes connecting perceiver and attended system serve as correlates of attention. There is complete symmetry between the two systems which conforms with the “Eastern” vision that there is no distinction between observer and observed during observation. The distinction emerges only after the observation is over and sensory percept has become a memory.

Also remote mental interactions should have ATP as a correlate of intentional action at the end of the operator and the rate of metabolism might be used as a correlate for the remote mental interaction such as psychokinesis or intentional imprinting or human-machine interactions.

### 5.6.2 How To Choose Senders And Receivers?

In the above discussion only the new physics phenomena suggested to be essential for both biology, neuroscience, and remote mental interactions are considered, and many experiments could be carried out without operator and target as they are used in remote mental interaction experiments. One might however hope that the model could give some idea about optimal planning of experiments related to remote mental interactions.

In these experiments an important aspect of testing is optimal choice of targets and the persons acting as sender.

1. Quite generally, the optimal target system for demonstrating these effects would be a critical system very sensitive to small perturbations. Any critical system would work, and one might even consider that the critical systems used to detect elementary particles might be used. Overcooled vapor or liquid or overheated liquid is one possibility. One could take register what happens in the system using same methods as in particle physics. Organic compounds might be by definition be this kind of systems.
2. One could also try to identify optimal “senders”. Persons with strong will power or with firm belief on the effect, or persons with lower level of inhibition (children, actors, artists, ...) could be considered as optimal “senders”. One could find whether some drugs which remove inhibition, could enhance telepathic and psycho-kinetic abilities. The “blessed are the meek since they quantum entangle” prediction could be also tested. Indeed, one of the most dramatic experiments supporting psychokinesis was done using chicken which imprinted

to a robot [J77]. The robot, whose behavior was programmed earlier by random number generator, tended to stay near the chicken, as if chicken had induced a quantum jumps changing the geometric past in macro-temporal time scales.

## 5.7 The Tip Of Iceberg: Placebo, Experimenter Expectation And Interference Phenomena In Subconscious Information Flow

The answers to the questions discussed below require a summary of the recent view about basic notions of TGD inspired theory of consciousness. The vision of Jeff Hawkins about neocortex led to a considerable updating of the vision about quantum jump as a moment of consciousness, and also about the notion of self allowing rather concrete connection with what happens in brain and the basic notions of Hawkins have quantum parts in TGD based vision. The question by Jean Burns inspired a model for how the memories and expectations of future are read without affecting the memories by using interaction free measurement. Remote mental interactions can be seen as special case of those occurring between magnetic body and biological body in TGD based view about living matter and brain and the answers to the questions rely on this vision.

### 5.7.1 The Vision Of Jeff Hawkins About Neo-Cortex

The progress in these aspects came from working out a general model for quantum jump in zero energy ontology (ZEO) with inspiration coming from the book of Jeff Hawkins (for book see <http://tinyurl.com/ybva3x1b>).

1. Hawkins suggests a general model for how neocortex constructs sensory representations and motor actions. One of his key observations is that these two basic operations look like time reversals of each other a model for sensory perception gives a model for motor action.
2. Hawkins emphasizes the role of time: not only spatial patterns but temporal sequences of them are stored in memory. Hawking introduces also the notions of invariant representation, association, abstraction and its reverse process, and hierarchy of abstraction levels having interpretation in terms of structure of neo-cortex and the basic question os what are the (possibly quantum) physical correlates of these notions.
3. Pattern recognition is the basic process and is carried out at various levels of hierarchy by comparing sensory input with standard patterns stored in memory. If the pattern fails to be recognized at given level it is sent to higher level where it is represented in lower resolution and might be recognized as a part of a larger pattern.

### 5.7.2 A Generalization To A Vision About The Anatomy Of Quantum Jump In Zero Energy Ontology

The vision seems to generalize to an interpretation of the anatomy of quantum jump by generalizing to various notions involved to quantum TGD context. This was to my a surprise. The basic observation and in zero energy ontology (ZEO) quantum jumps occur in two varieties: state function reduction to upper or lower boundary of causal diamond (CD). The interpretation for these two kinds of quantum jumps would be as generalizations for forming sensory representations and performing motor action. The processes would be carried out at various levels of the self hierarchy. Even at the level of elementary particles (see <http://tinyurl.com/yc46pq86>).

#### Sensory perception and motor action as time reversals of each other

In this framework sensory representations are not only (short term) memories but also predictions, symbolic representations for expectations and beliefs about future. Same applies to their p-adic counterparts defining cognitive representations in which sensory percept consists of objects. Motor actions correspond to sensory representations in reversed time direction and same statements apply to them as also their p-adic counterparts.

1. I assume the basic ideas about zero energy ontology (ZEO) and causal diamonds (CDs) known. Denote the light-like boundaries of causal diamond CD (cartesian product of the intersection of future and past directed light cones of  $M^4$  with  $CP_2$ ) by  $CD_{up}$  and  $CD_{low}$ . “Up” resp. “low” could be also taken to mean “future” resp. “past”. Let us use small letters  $a, b, ..$  for positive/negative energy states, which are state function reduced and thus look classical since particle numbers and quantum numbers are well-defined unless negentropic entanglement is present. Big letters are preserved for states which do not have this property. In any state of quantum jump sequence one has state of form  $(a, B)$  or  $(A, b)$  by the basic properties of state function reduction in ZEO. Note that state function reduction and state preparation are the same thing but occurring at opposite boundaries of CD in zero energy ontology.
2. Suppose first that  $CD_{low}$  is in a state function reduced state  $a$  with well defined single particle quantum numbers. State  $a$  could be regarded as an outcome of sensory perception process (top-down cascade of state function reductions with standard arrow of embedding space time) leading from perceptively fuzzy initial state to perceptively precise state. The state  $B$  at  $CD_{up}$  cannot be prepared/state function reduced if S-matrix is non-trivial and represents a superposition of states, something non-classical like qubit or Schrödinger’s cat. State  $B$  could be seen as a fuzzily defined goal, plan of future, or prediction resulting in sensory perception. This conforms with Hawking’s vision that sensory perception defines also a plan of future, expectation.

The p-adic variant of  $a \rightarrow B$  obtained by cognitive map mapping real space-time surfaces in the superposition to p-adic counterparts (these surfaces represent among other things nerve pulse patterns) would be cognitive representation, kind of symbolic representation describing the goal, expectation, or prediction, intention. Its fuzziness corresponds to the fact that we cannot predict future precisely.

3. Let us now make state function reduction at the opposite boundary  $CD_{up}$ , which after this is in perceptively precise state function reduced state  $b$ . The interaction is as motor action identified as time reversal of sensory perception.  $b$  represents now an achieved goal.  $b$  is of course not completely predictable and only the probability of particular  $b$  can be known.  $CD_{low}$  is state  $A$  with is not anymore state function reduced and classical looking. It can be interpreted the initial fuzzy motor plan represented as quantum superposition of options without fixing the details. The cascade of state function reductions proceeding from top to bottom for given CD and its sub-CDs only fixes the details.

The p-adic of this zero energy state would be cognitive representation for the realized motor action leading to final state  $b$ : a realized intention, cognitive representation for how intention was realized.

4. If this picture is correct, the outcomes of quantum jumps in ZEO would universally organized into a sequence of pairs  $(a_n, B_n), (A_n, b_n)$  of zero energy states corresponding to sensory perception and motor action and the basic structure for the functioning of conscious brain would be part of quantum theory. This decomposition would take place in various scales of the scale hierarchy (sheets of many-sheeted space-time with various time scales and CDs containing sub-CDs containing...). This picture is consistent with the vision of Hawking at the structural level and if true, brain would not be so special system as neuroscientists tend to think but could be seen only as a highly specialized and highly developed instrument for producing sensory and cognitive mental images and controlling the external world. Also the localization of contents of consciousness to brain alone would be misleading in this framework.

### Quantum counterpart of association

Association is key concept of neuroscience and should have quantum counterpart.

1. To explain the idea one needs first some words about Negentropy Maximization Principle (NMP). NMP is analogous to second law. It states that the information gain in state function reduction is maximal. One can define information gain as difference between informations of initial and final zero energy states. NMP implies standard quantum measurement theory

for Shannon entropy as entanglement entropy. If entanglement probabilities are rational numbers or even algebraic numbers one can however define a hierarchy of number theoretic entanglement entropies corresponding to various p-adic numbers fields  $Q_p$ ,  $p$  prime and in this case the entropy can be negative and thus describes information interpreted as information carried by the entanglement. The pairs in quantum superposition would represent instances of a rule. Entropy would in turn characterize the loss of information about the state of either entanglement system.

NMP is analogous to second law and its natural to imagine the analogs of temperature and various other parameters as characteristics of “thermal equilibrium” under some constraints with respect to NMP instead of second law. These would be macroscopic parameters characterising the state of consciousness, and one can easily imagine psychological counterparts of thermodynamical notions. Psychological pressure would not be a mere metaphor!

2. Negentropic entanglement (see **Fig.** <http://tgdtheory.fi/appfigures/cat.jpg> or **Fig. ??** in the appendix of this book) provides a model for associations as rules in which superposition of tensor product states defines rule with entanglement pairs defining its various instances. This generalizes to N-fold tensor products. Associations would be realized as N-neuron negentropic entanglement stable against NMP. One could also think of realizing associative areas in terms of neurons whose inputs form entangled tensor product and when sensory inputs are received they form analogous tensor product in representative degrees of freedom.

Thus negentropic entanglement is necessary for mental images (having sub-CDs as correlates) to mental images representing spatial patterns. Negentropic entanglement in time direction for these patterns (zero energy states) is in turn necessary to bind them to sequences of mental images representing abstract memories as sequences of mental images. Negentropically entangled sequence would be a quantal counterpart for the original association sequence introduced as purely geometric concept.

3. Collective consciousness could involve formation of associative (tensor product) networks analogous to neuronal networks as this kind of negentropically entangled tensor products. They could be very relevant for remote mental interactions. Experimenter effect, effect of group to remote mental interactions such as healing, etc... They would form hierarchy and the communications between hierarchy levels would be important. The remote viewer or healer would be only part of a bigger structure.

### 5.7.3 Self Or Only A Model Of Self?

Negentropic entanglement provides a model for associations as rules in which superposition of tensor product states defines rule with entanglement pairs defining its various instances. This generalizes to N-fold tensor products. Associations would be realized as N-neuron negentropic entanglement stable against NMP. One could also think of realizing associative areas in terms of neurons whose inputs form entangled tensor product and when sensory inputs are received they form analogous tensor product in representative degrees of freedom.

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This picture however challenges the identification of self as quantum jump. Should the negentropically entangled sequences of mental images define selves so that self would be something characterizing zero energy state rather than something identified as quantum jump? Could they define a model of self to be distinguished from self identified as quantum jump? Or could one give up the notion of self altogether and be satisfied with model of self? At this moment it seems that nothing is lost by assuming only the model of self.

By definition negentropic entanglement tends to be preserved in quantum jumps so that it represents information as approximate invariant: this conforms with the idea of invariant repre-



sensation and quite generally with the idea that invariants represent the useful information. There is however a problem involved. This information would not be conscious if the original view about conscious information as a change of information is accepted.

The recent formulation of TGD inspired theory as quantum measurement theory in Zero Energy Ontology and assuming NMP requires that negentropic entanglement assignable to the passive boundary of causal diamond (CD) is directly experienced and defines what might be called unchanging self. The active boundary defines the changing part of self - the “Maya”.

Sensory and memory representation based on bits assignable to the active boundary of CD are however possible. Could one imagine a reading mechanism in which this information is read without changing the representations at all? By non-cloning theorem this is too much to hope but one might achieve it with arbitrary accuracy. This reading process would be analogous to deducing the state of a two-state system in interaction free measurement to be discussed below in more detail. The interaction free measurement would thus allow to read memory representations constructed in terms of bits without changing them at all at the never-achievable idealized limit.

#### 5.7.4 Could Interaction Free Measurement Be Used To Read Memory Representations?

If memory representations are realized in terms of bits, there should exist a way to read them without changing them. No-cloning theorem prevents this but one can imagine a reading mechanism inducing no changes at idealized limit. The following proposal for non-destructive reading of memories and future plans allows to resolve this problem.

##### Bomb testing problem as a model for interaction free measurement

One can consider a generalization of so called interaction free measurement as a way to deduce information about self model realized in terms of bit representations. This information would be obtained as sequences of bits and might correspond to declarative, verbal memories rather than direct sensory experiences.

1. The bomb testing problem of Elitzur and Vaidman gives a nice concrete description of what happens in interaction free measurement, see <http://tinyurl.com/kx2jsyu> [B1] for an illustration of the system considered.

The challenge is to find whether the bomb is dud or not. Bomb explodes if it receives photon with given energy. The simplest test would explode all bombs. Interaction free measurement allows to make test by destroying only small number of bombs and at idealized limit no bombs are destroyed.

The system involves four lenses arranged in square and two detectors C and D at the upper right corner of the square. In the first lense at the lower left corner the incoming photon beam splits to reflected and transmitted beams: the path travelled by transmitted beam contains the bomb.

- (a) The bomb absorbs photon with a probability which tells the fraction of photon beam going to the path at which bomb is (is transmitted through the lense). The other possibility is that this measurement process creates a state in which photon travels along the other path (is reflected). This photon goes through a lense and ends up to detector C or D through lense.
  - (b) If the bomb is dud, the photon travels through both paths and interference at the lense leads the photon to detector D. If C detects photon we know that the bomb was not a dud without exploding it. If D detects the photon, it was either dud or not and we can repeat the experiment as long as bomb explodes, or C detects photon and stop if the detector continues to be D (dud). This arrangement can be refined so that at the ideal limit no explosions take place and all.
2. The measurement of bomb property is interaction free experiment in the sense that state function reduction performed by absorber/bomb can eliminate the interaction in the sense that photon travels along the path not containing the bomb. One might say that state

function reduction is an interaction which can eliminates the usual interaction with photon beam. State function reduction performed by bomb can change the history of photon so it travels along the path not containing the bomb.

This picture is only metaphorical representation of something much more general.

1. Bomb could be of course replaced with any two-state system absorbing photons in one state but not in the other state, say atom. Now one would test in which state the atom is gaining one bit of information in the optimal situation. Two-state atom could thus represent bit and one could in principle read the bit sequence formed by atoms (say in row) by this method without any photon absorption so that the row of atoms would remain in the original state.
2. Two-state system could be replaced with  $N$ -state system. In this case the testing selects at first step one state as analogs of bomb intact and the remaining states as analogs of dud. If the answer was “dud” in the first step, the next step selects one preferred state from  $N - 1$  states and regards the remaining states as “dud”. The process continues until the state of the system is measured.
3. In TGD framework the photon paths branching at lenses correspond to branching 3-surfaces analogous to branching strings in string model and photon wave splits to sum of waves travelling along the two paths.

### Memory recall as an interaction free measurement

One can imagine several applications if the information to be read in interaction free manner can be interpreted as bit sequences represented as states of two-state system. Lasers in ground states and its excited state would be analogous many particle quantum system. In TGD framework the analog of laser consisting of two space-time sheets with different sizes and different zero point kinetic energies would be the analogous system.

For instance, a model of memory recall with memories realized as negentropically entangled states such that each state represents a qubit can be considered.

1. Reading of a particular qubit of memory means sending of negative energy photon signal to the past, which can be absorbed in the reading process. The problem is however that the memory representation is changed in this process since two state system returns to the ground state. This could be seen as analog of no-cloning theorem (the read thoughts define the clone). Interaction free measurement could help to overcome the problem partially. Memory would not be affected at all at the limit so that no-cloning theorem would be circumvented at this limit.
2. A possible problem is that the analogs of detectors C and D for a given qubit are in geometric past and one must be able to decide whether it was C or D that absorbed the negative energy photon! Direct conscious experience should tell whether the detector C or D fired: could this experience correspond to visual quale black/white and more generally to a pair of complementary colors?
3. ZEO means that zero energy states appear have both embedding space arrows of time and these arrows appear alternately. This dichotomy would correspond to sensory representation-motor action dichotomy and would suggest that there is no fundamental difference between memory recall and future prediction by self model and they different only the direction of the signal.
4. Since photon absorption is the basic process, the conscious experience about the qubit pattern could be visual sensation or even some other kind of sensory qualia induced by the absorption of photons. The model for the lipids of cell membrane as pixels of a sensory screen suggests that neuronal/cell membranes could serve defined digital self model at the length scale of neurons.
5. Active/passive dichotomy can be represented in very simple manner physically. One has two state system in which lower energy state can be excited to a long lived higher energy state by

photon absorption. System in higher energy state is passive and that in lower energy state active.

This model can be applied also to telepathy and maybe also to ESP since the basic mechanism are expected to be the same.

### What abstraction means in zero energy ontology?

A further central notion used by Hawkins is that of abstraction.

1. For sensory and cognitive representations abstraction means just a process of forgetting irrelevant details besides going to a longer time and length scales (example: sequences of music pieces in CD is the mental image instead of single piece).
2. The more abstract the representation the longer the corresponding time scale is. This suggests that the sequences of negentropically entangled mental images get longer as abstraction level increases. In state function reduction the quantum superposition of CDs with second boundary localized contains all scales for CDs and reduction localizes the opposite boundary but forces de-localization of the original boundary. This also means that the average size of the CDs increases and the sequences of negentropically entangled sub-CDs become longer as new sub-CDs (mental images) are created. These sequences of sub-CDs would give rise not only to self but also self-model
3. Getting rid of details is the second aspect of abstraction. In TGD framework measurement/ cognitive/ sensory resolution is a natural concept in this respect and emerge unavoidably if one interprets cognitive representations as maps of real space-time surfaces to their p-adic counterparts. Only discrete set of rational (or perhaps algebraic) points of space-time surface can be mapped to their p-adic counterparts as such. The p-adic space-time surface is a completion obtains as a preferred extremal containing these points. There are in general very many preferred extremals with this property and their quantum superposition represents the cognitive representation in finite measurement resolution. Quantum superposition in given resolution defines therefore abstraction and increasing the level of abstraction means reduction of the resolution. Note that also the reverse maps from p-adic preferred extremals to real ones define reversals of cognitive maps and have realization as a transformation of intention to action.

### Remote mental interactions as a special case

This general model applied also to remote viewing and psychokinesis assumed to be special cases of what happens when magnetic body interacts with biological body, could provide new insights.

1. The first conclusion would be that several levels (scales) are probably involved in both processes: not only various hierarchical levels of brain (various sensory and motor areas, and their 6-layered structure, various size scales in brain anatomy) but also the hierarchy of magnetic bodies would be present meaning that remote mental interactions involve collective levels of consciousness rather than only the operator and target. The presence of these collective levels suggests that the experimenter effect and many other analogous effects considered in the questions are real.
2. In the case of brain self hierarchy allows to understand various agnosias [J15] which look mysterious if one assumes only single level in the self hierarchy. One of the agnosias is blind sight: person sees but does not see consciously. The visual areas of the person are intact. Person indeed receives the visual information as but some other level of self level sees becomes clear from the fact that she can perform motor actions possible only if there is an access to the visual information generated in visual areas. Simplest explanation would be that the sub-selves representing mental images do not negentropically entangle with the other sensory mental images: associative areas would not work as they should. Agnosia would be disorder in tensor producting! The would entangle with unconscious-to-us motor mental images. The

explanation would be that some other self in hierarchy enjoys visual consciousness, perhaps above, at same level, or several level below in the hierarchy.

Could remote viewing be like blind sight: one sees but not consciously - some lower or upper level in the self hierarchy remote views consciously and the remote viewer manages to guess some of this information? The presence of self hierarchy extending even to the level of magnetic bodies and collective levels of course complicate the modelling attempts. For instance, one must ask how can one know that remote viewer does not read the thoughts of some person in the experimental group instead of remote viewing. In any case, the presence of the hierarchy and the crucial role of attention would also explain the difficulties related to the interpretation of experiments.

3. Ironically, various experimenter effects and placebo effect might provide the strongest support for remote mental interactions and the effect of intentions and expectations to the future history. In ZEO sensory perception produces not only summary of what happened but also an expectation what will happen and one could interpret the expectation also as a quantum fuzzy goal. The next quantum jump realizes this motor plan. In ZEO we are really re-creating our reality repeatedly by just sensorily perceiving in the two different time directions. If one believes on hierarchy of Planck constants, and negentropic entanglement, the effects need not be minor anomalies masked by thermal fluctuations but can become manifest in everyday scales.

### 5.7.5 Possible Answers To The Questions

**Question 9:** Both Dr. Solvvin and Dr. Moddel have conducted remote influence studies (on animal models, respectively random event generators; Solvvin, 1982; Moddel, 2012) in which participants' expectation seemed to dominate the outcome. In the first case, animal handlers were told that half of their assigned mice were inoculated with babesia and half with sterile saline, and that half of each group would receive remote healing influence from an accomplished healer. In reality, all mice were inoculated with the same dose of babesia, and there was no remote healer. In spite of this, significant differences were recorded between "inoculated" and "control" groups, as well as between "healer" and "control" mice – which, the paper concluded, could only be attributable to handlers' expectations. In Moddel's study, where a random event generator (REG) was set up to arbitrarily shut off the power to another, sequence-recording REG, eventual loss of interest by the experimenters invariably resulted in the initially spectacular PK effect size dropping to non-significance levels.

Are you aware of similar experiments corroborating these results? Can you think of a way to isolate the experimenter expectation effect from the overall outcome? How significant do you think experimenter expectations may be in mainstream clinical trials? Could a reduced level of emotional trepidation/ expectancy build-up on the part of principal investigators in post-marketing drug trials, when compared to pre-approval phase, mirror the steep decline noted with Moddel's 2-REG experiments? What makes a system more susceptible to experimenter expectation?

**Answer:** One could understand these findings qualitatively in the proposed general vision. In particular, the loss of interest means that experimenter does not anymore direct attention to situation and there is no intention to achieve desired results. If emotions basically correspond to negentropy gradients then their lack means that attention is not directed to the target.

**Question 10:** Like the REG/DMILS studies above, the Schlitz/Wiseman experiments (Wiseman and Schlitz, 1998) suggest that the ganzfeld process is susceptible to experimenter expectation. However, these correlations are not consistent - successful remote viewing and PK have also been achieved in the presence of skeptics. Is there any supporting evidence for experimenter expectation in the GCP data or in other field-REG studies? Do you feel that some psi processes may be more robust in the face of experimenter expectation – for example, that the spontaneous mass emotional response typically associated with the major events registered by the Global Consciousness Project is more likely to dominate the outcome than the motivation of a typical operator trying to affect a bench top random event generator in the classical REG experiment?

**Answer:** Ganzfeld process would seem to be almost by definition a process involving several collective levels of consciousness so that if the vision discussed in the beginning makes sense, one could expect the susceptibility. What I fail to understand is how mass emotional response could lead to coherent effect on REG since the intention to obtain definite deviation from true randomness is obviously lacking.

Maybe one could think some kind of effect - via say periodic perturbation of magnetic fields of the collective magnetic body (Schumann resonances?) transferred also to the magnetic body assignable to the recording. William Tiller has reported this kind of effects due to intentional action in his books. I have proposed a rather crazy idea of demonstration of PK leaving no doubt about its reality by comparing records of RG with affected by PK able person with those not affected in this manner (see <http://tinyurl.com/yckq32pv>).

**Question 11:** In “The Possible Role Of Intention, Attention And Expectation In Remote Viewing” (see <http://tinyurl.com/yacazbus>) (May and McMoneagle, 2004) the authors argue that the sharply focused attention of all unit personnel on the one assigned task while doing operational remote viewing was likely responsible for the exceptional level of data produced. This seems to be corroborated by a series of experiments (Watt, 2003) in which subjects’ focus on a given task was shown to be significantly enhanced by a remote “assistant” concentrating their supportive attention on the operators. If these findings are correct, then it would seem that attention itself is a cumulative network phenomenon. Could that joint mass focus on the event being studied be a factor in the remarkable consistency of GCP results? **Answer:** To answer this question as

a physicists one should have a physical model for attention. My own model of attention relies on the identification of magnetic flux tube connections as a correlate of attention. Negentropic entanglement is present bringing in conscious information at this level of self hierarchy. Flux tubes create also quantum coherence in the sense that the systems connected by flux tubes form a single quantum coherent system in some degrees of freedom (dark matter with large value of  $\hbar_{eff}$  at connecting flux tubes and systems themselves).

Sharply focused attention of all unit personnel means that the level of consciousness of the collective mind created in this manner is high and one can expected that remote viewing is more effective. Note that remote viewing as analog of sensory perception would involve information transfer between different levels of this hierarchy in both directions: to abstraction and back to more detailed view.

**Question 12** (from B. Millar): Are there effects known in physics where three or more initially separate systems become quantum coupled or entangled? Do these have any consequences for remote mind-mind and mind-matter interactions?

**Answer:** There are. Quantum entanglement between electrons of atom and at molecular level are this kind of phenomena. Also quantum entanglement between valence quarks inside proton ( $N=3$ ). 2-particle entanglement is however special. So called monogamy theorem states that system can have maximally entropic entanglement with single system only. Therefore maximal entanglement between A and B, A and C, and B and C is not possible in 3-particle entanglement. The really happy couple must isolate themselves from the rest of the world!

**Question 13** (from J. Burns): We know through abundant evidence that ESP can travel without any physical signal to carry it. Up until recently the only way known, according to physical laws, to make a connection with no physical signal was through quantum entangled states. This possible method for the travel of ESP has the problem that quantum entanglement does not allow the transmission of information, but only correlations between certain events. However, it is thought that perhaps the extension of currently known quantum mechanics, which describes the interactions of matter, to incorporate interaction with consciousness might then provide an explanation.

However, recently a method has been proposed in which, according to the presently known laws of quantum mechanics, information can be transferred without a physical signal (see <http://tinyurl.com/cr5e6tzapr/16/alice-and-bob-communicate-without-transferring-a-single-photon>). It differs from the latter method in that it uses the Zeno effect, which is produced through multi-

ple instances of de-coherence, such as wave function collapse or interaction with the environment. Which method do you favor as a means by which ESP can travel? Why? If you favor a third method, please describe.

**Answer:** I already described the interaction free measurement realized in terms of lenses and photon beams. The bomb testing problem of Elitzur and Vaidman gives a nice concrete description of what happens (see <http://tinyurl.com/kx2jsyu>).

The basic idea of interaction free measurement and its possible application to memory recall allowing to avoid destruction of the memory represented in terms of bits (sub-selves, sub-CDs) was discussed in the first section ???. It was noticed that the absorption of photons could give rise to visual quale (black/white) as a representation for the bit that has been read and that the lipids of cell membrane could serve as pixels of sensory screen allowing to define mental images at neuronal level of self hierarchy.

One can imagine several applications if the information to be read in interaction free manner can be interpreted as bit sequences represented as states of two-state system. Lasers in ground states and its excited state would be analogous many particle quantum system. In TGD framework the analog of laser consisting of two space-time sheets with different sizes and different zero point kinetic energies would be the analogous system.

1. Mind reading - telepathy - might be possible using this mechanism if thoughts are expressible as qubit sequences or more general patterns. The mind reader sends a split beam of photons to the system which it wants to read. The target notices nothing at the idealized limit since no photons are absorbed by the target but a pair of systems analogous to detectors C and D: mind reader must of course be able to see whether either of these systems detects a photon.

This mechanism would differ from TGD inspired model of telepathy based on TGD inspired notion of sharing of mental images. Sharing of mental images requires that entanglement of mental images is possible although systems having those mental images as sub-selves (sub-systems) are not entangled. This is possible if one accepts TGD based view about space-time and corresponding view about hierarchy of subsystems. One can have two disjoint space-time sheets containing topologically condensed smaller space-time sheets which are connected by flux tubes. In the resolution of larger space-time sheets there is no entanglement. In the resolution of smaller space-time sheets there is entanglement and shared mental images.

2. Could this model apply to ESP?
  - (a) The recent TGD based model of ESP relies on much more classical picture. Magnetic flux tubes generated by remote viewer and serving as correlates of attention connect the remote viewer with the target (here macroscopic quantum coherence is required). Along the flux tubes travel the dark photon beams (photons with large  $\hbar_{eff}$  and thus scaled up wavelength for given energy) and are reflected at the second end and return back. This is very much like ordinary seeing using lamp but forcing the light beams to travel inside flux tubes so that the intensity of beam is not reduced with distance.
  - (b) There does not seem to be any compelling need for interaction free ESP as there is in the case of reading of negentropically entangled memories or future predictions.
  - (c) Furthermore, visual perception does not seem to be a process in which qubits are read. Note however that in the above described model reading of memories involves photon absorption by system C or D: these systems code for the values of bit and one could assign to this process a visual quale.

**Question 14:** If PK is goal-oriented, independent of an operator's understanding of the complex physical or biological mechanisms involved in achieving the desired effect, then should we assume that the operator is essentially interacting with the target at a future point in time, with causality apparently flowing backward to the present, to affect the target and all those connected to it ? Does the universe we share then find its probability course like a stream shaped by the resultant landscape of our collective intents, beliefs and expectations?

**Answer:** One could understand the possibility of PK without understanding how it is achieved, if the operator is only a part of collective mind. Although operator knows nothing about mechanisms, the higher or lower levels might know and could help to reach the desired effect. PK as any motor action would be a cascade proceeding from higher levels to lower ones with a lot of feedback if the lower level is not able to realize what higher level wants so that command is sent back for refinement.

In ZEO motor action can be indeed seen as a time reversal of sensory perception which also involves a lot of feedback between different abstraction levels (representations in given resolution with poorer resolution meaning higher abstraction resulting from forgetting the irrelevant details). Libet's findings support this picture in small time scales.

Also higher collective levels would be present (having magnetic bodies as correlates). This could mean that collective intents, beliefs, and expectations are indeed important and universe is reconstructed repeatedly even in macroscopic scales, as we indeed experience it to be.

**Question 15** (B. Millar): Eminent parapsychologists are almost unanimous that understanding experimenter effect is crucial for the field. All this lip service has resulted in remarkably little experimental action. Why is this and what can be done to improve matters? **Answer:** I

think that the problem is that precise enough theoretical frameworks are lacking. The situation is also circular. Experimenter effect is itself remote mental interaction and it is remote interactions we try to understand by doing experiments!

**Question 16:** We are currently operating under the working assumption that any such consciousness - related anomalies are peripheral to our routine activities and small enough to be absorbed by the tolerances built into our systems. Is that a correct assumption – and if not, which areas do you think are most susceptible to these poorly-understood effects? How critical could they become? **Answer:** If I take seriously the vision about quantum jump sequence as a

universal cognitive algorithm involving large number scales and self hierarchy, I must be also ready to consider the possibility that the effects are not always small. Understanding of anomalies of ordinary consciousness in terms of self hierarchy might help considerably also in this problem.

## Chapter 6

# Hypnosis as remote mental interaction

### 6.1 Introduction

In TGD framework one can argue that hypnosis represents an example about the fact that brain is not “private property”: hypnotist uses the biological body and brain of the subject as instrument. Therefore remote mental interaction is in question. This idea generalizes: if one accepts self hierarchy, one can assign to any kind of higher level structure - family, organization, species,... - a higher level self and magnetic body carrying dark matter, and these magnetic bodies can use lower level magnetic bodies as their instruments to realize their intentions. Biological bodies would be an important level in the hierarchy, which would continue down to cellular, molecular, and perhaps to even lower levels.

This view challenges the prevailing views about brain as a sole seat of consciousness and the assumption that conscious entities assigned with brains are completely isolated. Given magnetic body can use several biological bodies although one can assign to it the one providing the sensory input - at least during wake-up state. Note however that it is easy to produce illusion that some foreign object is part of biological body.

For more than decade ago I proposed a model for so called bicamerality based on the notion of semitrance [K83, K84]. In semitrance the brain of subject becomes partially entangled with a higher level self - in this case the self of family or more general social group uses the biological body of member for its purposes. Higher level self gives its commands and advice interpreted by the bicameral as “God’s voice”. The consciousness of schizophrenic might be basically bicameral. Also hypnotic state and dream consciousness are candidates for bicameral consciousness.

#### 6.1.1 Hypnosis As Hijacking Of Brain?

In TGD framework hypnotist and subject would partially share the biological body of the subject, and hypnotist could realize motor actions using the biological body of the subject and also induce sensory experiences by sending suggestions generating virtual sensory input to the sense organs of the subject (this if one accepts TGD view about the role of sensory organs).

One could see hypnosis as a kind of hijacking of some parts of the subject’s brain. Could one identify these parts? The general finding is that there is no universal neural or EEG signature of hypnotic state and possible changes in neural activity can be interpreted as neural correlates of imagination. Only in the case of persons highly susceptible to hypnotic induction one can identify a change of neural activity pattern identifiable as a correlate of hypnotic state.

“Hijacking” can be of course criticized for its negative tone. A more positive way to express the idea is to say that the subject is voluntarily provides part of her brain to the use of the hypnotist’s magnetic body. This conforms with the acronym “TEAM” symbolizing the subject’s orientation to hypnosis in terms of “trust”, “expectation”, “attitude”, and “motivation”.

The neurophysiological findings conform with the view that the really interesting phenomena take at the level of magnetic bodies. The changes - when they occur - take place in prefrontal cortex



(PFC) (see <http://tinyurl.com/642r4t>) [J12] and anterior cingulate cortex (ACC) (see <http://tinyurl.com/2yykqh>) [J3]: this together what is known about methods of hypnotic induction provides hints about what might occur in the hijacking process. The almost-prediction would be a correlation between EEGs of the hypnotist and subject person reflecting the sharing of parts of the subject's brain. It would be therefore highly interesting to study the correlations of the EEGs of subject and hypnotist.

Strongly focused attention to hypnotic suggestion is mentioned as a basic aspect of hypnosis and distinguishes it sharply from sleep. This feature brings in mind various altered states of consciousness reached in meditation and it has been suggested that meditation is one form of self-hypnosis. In TGD framework personal magnetic body has layered onion-like structure with layers characterized by p-adic length and time scales and the value of  $\hbar_{eff}$ . Therefore meditative state could be seen as a re-sharing of biological body and brain by these layers and even by foreign magnetic bodies.

### 6.1.2 Do Social Interactions Share Something With Hypnosis?

More generally, one can also ask whether the phenomena of collaboration and synergy on one hand, and influence, "power" and fight for power on the other hand, could be modelled in terms of the partial ownership of the biological bodies by magnetic bodies identified as intentional agents.

Social structures and organizations are complex networks in which the arrows characterizing relationships between individuals in the simplest situations are uni-directional and static. The person at either end of the arrow is in command. In more complex situations members are connected by several arrows of this kind, their directions can vary, and need not be static.

Should one therefore give up what physicist would call "single-particle" view and replace it with "many-particle" view by bringing in the notion of magnetic body attaching to several biological bodies and organizing them to loosely bound states of individuals? Under what conditions this kind of partial fusion of conscious entities can take place? Does it occur only when there is complete trust in either direction or can fear about consequences be enough? It would not be surprising if immune systems against hijacking of the biological body would have evolved: this would allow to understand why the reality of remote mental interactions is so difficult to demonstrate. They could however take place on daily basis in social interactions if the proposed picture makes sense.

The dynamical sharing of biological bodies can be seen also positively: this sharing would make possible collaboration and synergy at much deeper level than we have been used to think. This kind of shared use of biological bodies perhaps defines the direction to which human kind should proceed. Also the possibility to directly experience what it is to be "the other one" - something not allowed by the standard view about consciousness confined inside individual brain - is implicated.

The new view about influence and power might allow to understand better the often highly irrational looking behaviors of organizations and their members - in particular blind obedience of orders and fight for power. The hierarchy of magnetic bodies could serve as a physical correlate for the hierarchy of biological and social structures. In particular, the fight for power could be seen as fight between magnetic bodies for the ownership of biological bodies or lower level magnetic bodies. The dark matter realized as a hierarchy of phases with non-standard value of effective Planck constant would represent a new physics necessary for understanding the physical correlates of these phenomena.

In the sequel I will introduce some basic notions, ideas and theories about hypnosis (see <http://tinyurl.com/mgy2e>): the Wikipedia article [J7] gives a good overall view about the subject. The techniques of hypnotic induction provide valuable clues if one wants to imagine what hypnosis is. I will also describe the classical test for hypnotic susceptibility using Chevreul pendulum (to me it was quite a stunning experience to find that I am highly susceptible to hypnotic induction!), and propose an explanation in terms of hijacking of PFC and ACC by the magnetic body of hypnotist. The model makes an assumption about the logic of brain functions. Imagined motor action "Don't (really) do this" is realized as "Do this" followed by "Don't" stopping the imagined motor action proceeding otherwise from the magnetic body to PFC to motor regions of cortex via ACC to a real motor action.

In TGD framework sensory perception and motor action are related by time reversal and therefore an analogous mechanism applies to imagination realized as a genuine hallucination unless “Don’t” is realized. Hypnotist should therefore hijack the brain regions realizing “Don’t” by catching their attention so that they cannot perform their function. ACC is a good candidate for the region in which “Don’t” is realized under normal circumstances. This logic makes possible to induce motor actions and sensory hallucinations analogous to dreams. Dreams would be realized in terms of virtual sensory input to sensory organs (REM) rather than only to higher levels in hierarchy of sensory representations at cortex, which do not carry visual qualia conscious-to-us.

The appendix of the book gives a summary about basic concepts of TGD with illustrations. Pdf representation of same files serving as a kind of glossary can be found at <http://tgdtheory.fi/tgdglossary.pdf> [L15].

## 6.2 Basic Facts About Hypnosis

The reader is recommended to read the Wikipedia article (see <http://tinyurl.com/mgy2e>) about hypnosis [J7] as a good introductory summary. The article begins by stating the basic big question about hypnosis: Can hypnosis be regarded either as a mental state (altered state of consciousness) or as an imaginative role-enactment? The first option conforms with the basic assumption of most existing theories of consciousness: consciousness is something completely private and in materialistic dogma reduces to the state of brain. Second option does not accept hypnosis as a genuine brain state and emphasizes the interaction between hypnotist and subject. Combined with standard neuroscience also this approach tries to understand hypnosis as single-brain phenomenon. In TGD view hypnosis is seen as a phenomenon involving two magnetic bodies interacting with single brain.

Also the heightened focus and concentration to a dominating idea (suggestion) blocking out sources of distraction is mentioned as characteristic of hypnosis and some theories emphasize this aspect instead of seeing hypnosis as a trance state.

The following discussion relies heavily on the Wikipedia article adding TGD inspired comments in the hope that they would help the reader to see the distinctions between TGD approach and more standard approaches.

### 6.2.1 Basic Definitions

In the following basic definitions of hypnosis are considered. The discussion follows the Wikipedia article with TGD inspired comments.

#### Definition of hypnosis

Braid’s original definition of hypnosis was following:

*[...] the real origin and essence of the hypnotic condition, is the induction of a habit of abstraction or mental concentration, in which, as in reverie or spontaneous abstraction, the powers of the mind are so much engrossed with a single idea or train of thought, as, for the nonce, to render the individual unconscious of, or indifferently conscious to, all other ideas, impressions, or trains of thought. The hypnotic sleep, therefore, is the very antithesis or opposite mental and physical condition to that which precedes and accompanies common sleep [...]*

Braid defined hypnotism as a state of mental concentration that often leads to a form of progressive relaxation, termed “nervous sleep”. Later, in his “The Physiology of Fascination” (1855), Braid concluded that his original terminology was misleading, and argued that the term “hypnotism” (“hypnos” refers to sleep) or “nervous sleep” should be reserved for the minority (10 %) of subjects who exhibit amnesia, substituting the term “monoideism”, meaning concentration upon a single idea, as a description for the more alert state experienced by the others.

The recent official definition of hypnosis is following:

*Hypnosis typically involves an introduction to the procedure during which the subject is told that suggestions for imaginative experiences will be presented. The hypnotic induction is an extended initial suggestion for using one's imagination, and may contain further elaborations of the introduction. A hypnotic procedure is used to encourage and evaluate responses to suggestions. When using hypnosis, one person (the subject) is guided by another (the hypnotist) to respond to suggestions for changes in subjective experience, alterations in perception, sensation, emotion, thought or behavior. Persons can also learn self-hypnosis, which is the act of administering hypnotic procedures on one's own. If the subject responds to hypnotic suggestions, it is generally inferred that hypnosis has been induced. Many believe that hypnotic responses and experiences are characteristic of a hypnotic state. While some think that it is not necessary to use the word "hypnosis" as part of the hypnotic induction, others view it as essential.*

### Induction

Hypnosis is preceded by induction phase, which according to state theorists leads into a "hypnotic trance" whereas "non-state" theorists view induction as "means of heightening client expectation, defining their role, focusing attention".

There exists a large number of induction techniques. The oldest and still dominant one is the eye fixation technique used by Braid and focusing the visual attention to some object - say oscillating pendulum. Ericksonian hypnotherapy relies on indirect techniques to induce trance states. Almost all methods used by Erickson - say handshake induction - rely on confusion as a way to induce hypnotic state. Erickson sees the resistance to direct suggestions as the basic challenge and used therefore indirect suggestions including so called double bind ("Shall we consider this problem now or perhaps later?") are used. Erickson saw hypnosis as a bi-directional process: also therapist can occasionally be in trance.

#### *Remarks:*

1. What notions like "role" and "client expectation" have as quantum physical correlates is of course unclear since even the notion of "consciousness" is poorly understood physically.
2. It has been proposed that all brain states are kind of hypnotic trance states: this extremist view brings in mind the view about magnetic body as a controller of brain and in this sense a hypnotist.
3. The unconscious-to-us fast visual pathway traverses through ACC, which suggests that the activation of ACC by visual attention to pendulum or some other object is involved in eye fixation technique. One can also ask whether flux tube connections retina - pendulum - retina are formed and whether the motion of pendulum promotes the their formation, perhaps in the same manner as "Mesmeric passes" might do.
4. ACC is the part of brain which seems to be involved with the treatment of conflicting situations and Francis Crick has identified it as a candidate for a locus of free will. This supports the view that ACC is indeed essential in the induction of hypnosis.

### Suggestion

Braid did not refer to suggestion in his definition of hypnotic state but saw it as focusing of the attention of subject upon a single idea. Later Braid however placed emphasis on using different verbal and non-verbal suggestions.

Bernheim shifted the emphasis from hypnosis as a physical state to the physical process of suggestion:

*I define hypnotism as the induction of a peculiar psychological [i.e., mental] condition which increases the susceptibility to suggestion. Often, it is true, the [hypnotic] sleep that may be induced facilitates suggestion, but it is not the necessary preliminary. It is suggestion that rules hypnotism.*

Suggestion can take place permissively or in authoritarian manner. One can distinguish between direct and indirect verbal suggestions such as insinuations, requests, metaphors, and stories. There are also nonverbal suggestions and both immediate and posthypnotic suggestions are used in hypnotherapy. Also subliminal suggestions involving visual inputs lasting so short time that there is no conscious experience: at least in this case the unconscious-to-us fast visual pathway through ACC would be naturally involved.

#### 1. *Consciousness vs. subconsciousness*

One of the basic issues related to hypnosis whether the suggestion is communication to the conscious or unconscious mind of the subject. Braid and Bernheim believed on conscious mind whereas Freud, Janet, and Erickson believe that sub-conscious mind is essential.

There is also the question whether a person in deep hypnosis is conscious. It seems that this is the case: for instance, person can report about sensory experiences during hypnosis if the hypnotist requests this. The focused attention with the reduction of peripheral awareness and increased response to suggestions seem to characterize the hypnosis.

*Remark:* In TGD framework subconscious and unconscious translate to “not conscious-to-us” and - according to the theory to be discussed - the highest level of subject’s brain consciousness having FCC as brain correlate could fuse with that of hypnotist’s magnetic body.

#### 2. *Ideo-dynamic reflex*

The first theory of hypnotic state was introduced by Braid, and was based on ideomotor reflex response (see <http://tinyurl.com/2cgs2am>) . The notion was originally introduced by William Carpenter, a friend of Braid. Carpenter observed that under certain circumstances the mere idea of muscular movement induce a small reflexive motor response.

Chevrel pendulum allows to demonstrate the ideomotor reflex response in the case of highly susceptible subjects. The mere imagination of motor action producing the motion of the pendulum induces its motion and it seems that the imagination of motion generates the neural activity leading to the motion which due to the hypnotic induction is not stopped so that it can develop to a real motor action.

*Remark:* One could interpret ideomotor reflex in TGD framework as imagined motor action identified as a genuine motor action which proceeds downwards from PFC but is stopped before reaching muscles. Sensory perception has an analogous interpretation as time reversal of motor action. During hypnosis this halting mechanism would be inhibited. This process would be one particular example of inhibition, which is basic mechanism of neural activity: in fact, the role of inhibition becomes more and more important during evolution.

### Susceptibility

Hypnotic suggestibility (see <http://tinyurl.com/3m93r5>) [J7] measures how easily the person can be hypnotized.

Braid distinguished between different stages of hypnotism: sub-hypnotic state, full hypnotic state, and hypnotic coma. Charcot made similar classification using the attributes lethargic, somnambulistic, and cataleptic. Liebeault and Bernheim introduced a more refined classification based on a combination of behavioral, physiological and subjective responses. At 20th century more refined scales were introduced. The most common scales are the Harvard Group Scale of Hypnotic Susceptibility and the Stanford Hypnotic Susceptibility Scales.

Most scales measure nowadays the degree of observed or self-evaluated responsiveness to specific suggestion tests. Normal (80 % of population), high (10 % of population), and low (10 % of population) is the simplest characterization of susceptibility. Highly susceptible subjects have been classified to fantasizers and dissociators. Fantasizers have often had parents who have encouraged imagination. Dissociators have typically a life history involving childhood abuse or some other trauma, and they have learned to escape into numbness and forget unpleasant events. The association to day-dreaming is “going blank” rather than fantasizing wildly.

### 6.2.2 A Brief History Of Hypnosis And Theories Of Hypnosis

Hypnosis has pre-cursors in yoga and meditation practices. Meditation could be seen as self-hypnosis (if hypnosis is “two-particle phenomenon”, one can wonder what this might mean!). The intense focusing of attention on single mental image can be seen as a common aspect of hypnosis and meditation practices.

Franz Mesmer (see <http://tinyurl.com/rs8qu>) [J5] was the pioneer of hypnosis. He used magnets to induce hypnotic state but later noticed that the same effects can be induced by passing the hands, at a distance from the subject’s body (“Mesmeric passes”). Mesmer believed on what he called “animal magnetism” according to which Universe was filled with some kind of magnetic fluid. At the request of King Louis XVI a Board of Inquiry having as members Antoine Lavoisier, Benjamin Franklin and an expert in pain control, Joseph-Ignace Guillotin (better known in somewhat different context), started to study whether animal magnetism is real. The effects were found to be real but placebo controlled experiments convinced the board that mesmerism was most likely due to belief and imagination rather than any sort of energy flowing from the hands of Mesmer.

*Remark:* In TGD approach to consciousness the flux quanta of magnetic bodies carrying dark matter become the key players of life and consciousness, and are also crucial for the understanding of hypnosis. Somewhat ironically, Mesmer might be making come-back. The effects would be mostly due to imagination but the hands of Mesmer might have induced magnetic flux tube connections making possible the hijacking of the brain of the subject!

James Braid (see <http://tinyurl.com/3s86z86>) [J8] revisited both the theory and practise of Mesmerism trying to reduce mesmerism to physiology and psychology. Braid emphasized the differences between sleep and hypnosis. He did not believe in any kind of magnetism or supernatural occult influence.

Besides Mesmer and Braid, Bernheim, Janet, Freud, Coue, Hull, Elman, Erickson (see <http://tinyurl.com/y4cp73r>) [J4] are pioneers of hypnosis. Bernheim was a follower of Braid and emphasized suggestion as an essential element of hypnosis instead of viewing hypnosis as a trance state possessed by Braid.

Freud was highly enthusiastic about hypnosis and even wrote a book about hypnotherapy. After the advent of psychoanalysis he started to emphasize the role of free association as a road to unconscious mind. Freud however saw hypnosis as a fast alternative to time taking psycho-analytic therapy. As already described, Erickson developed his own hypno-therapy based on the use of confusion as a manner to achieve hypnotic induction. Erickson also realized that the hypnotic induction can work in both directions.

#### The notion of dissociation

Janet (see <http://tinyurl.com/g55mo>) introduced the notion of dissociation of the control of behavior from ordinary consciousness [J7]. Hilgard introduced later the notion of neo-dissociation: the subject divides her mind voluntarily so that the other part responds to the hypnotist and the other part corresponds to the awareness of the subject. Hilgard made subjects take an ice water bath. They said nothing about the water being cold or feeling pain. Hilgard then asked the subjects to lift their index finger if they felt pain and 70 % of the subjects lifted their index finger. This showed that even though the subjects were listening to the suggestive hypnotist they still sensed the water’s temperature.

Mind-dissociation theory of Tsai generalizes the notion of dissociation so that any function of mind can be dissociated. For instance, imagination can be dissociated leading to dreams, some sense can be dissociated leading to hypnotic anesthesia, motor function can be dissociated leading to immobility, “reason” (volition) can be dissociated so that the subject obeys the hypnotist’s orders, ...

#### Hypnotism as imagination becoming reality

A complementary view about hypnosis is as imagination, which becomes reality. Persons highly susceptible to hypnosis have been classified as either dissociators and fantasizers. Hence it seems that both views contain a germ of truth.

*Remarks:*

1. In TGD approach dissociation of the control of behavior from conscious mind has a concrete interpretation. The magnetic body of the hypnotist hijacks the prefrontal cortex responsible for the control of behavior. The division of the subject's mind claimed by the neo-dissociation theory conforms with this notion. Also braid regions responsible for other brain functions can be hijacked in this manner so that a picture analogous to that of Tsai emerges.
2. Also the role of imagination can be understood. Hypnotist can prevent the halting of the neural process behind motor imagination so that it transforms to genuine motor action. This hijacking and transformation of imagination to a real action applies also to sensory perception, which in TGD framework is time reversal for motor action and behavior and allows to understand sensory hallucinations induced by hypnotist.

### Two key questions

In the following the history of hypnosis is discussed with emphasis on two questions.

1. Is hypnosis a genuine (altered) state of consciousness or is it a kind of role taking (partially unconscious) and learned social behavior possibly motivated by the need to appeal to the hypnotist?
2. Is hypnotic induction a message to conscious mind or subconscious/unconscious mind. Braid saw hypnotic suggestions as messages to the conscious mind whereas both Janet, Freud, and Erickson believed that hypnotic induction is communication with unconscious mind.

*Remark:* Self hierarchy implies that “unconscious” translates to “unconscious-to-us” in TGD framework. In TGD framework hypnotic induction would be a message to both conscious and unconscious-to-us levels of self hierarchy. The first guess would be that PFC serves as the neuro-anatomical correlate for conscious mind and ACC to that for unconscious mind. Fractality understood as abstraction hierarchy inspires the question whether PFC is same for cognition about cognition as ACC is for cognition.

### State or no-state?

Braid saw hypnosis as a sequence of trance states whereas Bernheim did not believe hypnosis as state and saw suggestion as a key element of hypnosis and thus the interaction between hypnotist and subject. Erickson believed that trance states occur continually in everyday life (day-dreaming and situations in confusing situations) and that also hypnotist can fall in trance state.

Social role taking theory of Sarbin [J81] and cognitive-behavioral theory of Barber, Spanos, and Chaves [J21] took the latter view to extreme. According to social role taking theory hypnotic behaviour would be meaningful, goal-directed striving, its most general goal being to behave like a hypnotised person as this is continuously defined by the operator and understood by the client. Obviously this definition does not apply to self-hypnosis nor allows the interpretation of meditative states as self-hypnosis.

Pavlov could be seen a predecessor of cognitive-behavioral approach. Pavlov saw hypnosis as learned associations and conditioned inhibition. The argument was that the words used by hypnotist reach the whole cortex and can replace all signals reaching cortex and can therefore induce also behavioral reflexes.

The cognitive-behavioural theory of hypnosis is in some respects similar to Sarbin's social role-taking theory. In particular, Barber argued that responses to hypnotic suggestions were mediated by a “positive cognitive set” consisting of positive expectations, attitudes, and motivation. Daniel Araoz subsequently coined the acronym “TEAM” to symbolize the subject's orientation to hypnosis in terms of “trust”, “expectation”, “attitude”, and “motivation”.

*Remarks:*

1. No clear neuro-physiological correlates for a unique hypnotic state have been found except some signatures in the case of highly susceptible subjects. This does not support the interpretation of hypnosis as an altered state of consciousness if hypnosis is interpreted as “single-brain” phenomenon. In TGD framework hypnosis would involve the magnetic body of hypnotist and even altered states of consciousness achieved in meditation could be seen as analogs of hypnotic states (self-hypnosis). Hence the two views about hypnosis would be consistent in TGD framework.
2. Although the approach of Pavlov (see <http://tinyurl.com/z3vms>) looks like exaggeration it might make sense in TGD framework if reflex action is seen as standardized mental image accompanied by a pattern of neural activity. If patterns of neural activity define representations of imagined motor actions and sensory percepts and if also speech reduces to this kind of patterns, one can imagine that the mechanism inhibiting the inhibition of imagination from proceeding to real motor action or sensory percept can produce motor actions and sensory percepts. The acronym TEAM could be interpreted as listing the prerequisites for the readiness of subject to allow hypnotist to use the brain of subject.

### 6.2.3 Neuropsychology And Hypnosis

One can find in Wikipedia article a short summary about neuropsychology of hypnosis.

*Neurological imaging techniques provide no evidence for a neurological pattern that could be equated with a “hypnotic trance”. Changes in brain activity have been found in some studies of highly responsive hypnotic subjects. These changes vary depending upon the type of suggestions being given. However, what these results indicate is unclear. They might indicate that suggestions genuinely produce changes in perception or experience that are not simply a result of imagination. However, in normal circumstances without hypnosis, the brain regions associated with motion detection are activated both when motion is seen and when motion is imagined, without any changes in the subjects perception or experience. This may therefore indicate that highly suggestible hypnotic subjects are simply activating to a greater extent the areas of the brain used in imagination, without real perceptual changes. It is, however, premature to claim that hypnosis and meditation are mediated by similar brain systems and neural mechanisms.*

According to Wikipedia article another study has demonstrated that a color hallucination suggestion given to subjects in hypnosis activated color-processing regions of the occipital cortex. A 2004 review of research examining the EEG laboratory work in this area concludes:

*Hypnosis is not a unitary state and therefore should show different patterns of EEG activity depending upon the task being experienced. In our evaluation of the literature, enhanced theta is observed during hypnosis when there is task performance or concentrative hypnosis, but not when the highly hypnotizable individuals are passively relaxed, somewhat sleepy and/or more diffuse in their attention.*

Hypnotic suggestion seems to enhance imagination: this conforms with the basic vision that hypnosis involves strong concentration on suggestion defining what is imagined.

The induction phase of hypnosis may also affect the activity in brain regions that control intention and process conflict. According to Anna Gosline:

*Gruzelier and his colleagues studied brain activity using an fMRI while subjects completed a standard cognitive exercise, called the Stroop task. The team screened subjects before the study and chose 12 that were highly susceptible to hypnosis and 12 with low susceptibility. They all completed the task in the fMRI under normal conditions and then again under hypnosis. Throughout the study, both groups were consistent in their task results, achieving similar scores regardless of their mental state. During their first task session, before hypnosis, there were no significant differences in brain activity between the groups. But under hypnosis, Gruzelier found that the highly susceptible subjects showed significantly more brain activity in the anterior cingulate gyrus than the weakly susceptible subjects. This area of the brain has been shown to respond to errors and evaluate emotional outcomes. The highly susceptible group also showed much greater brain activity on the left side of the prefrontal cortex than the weakly susceptible group. This is an area involved with higher level cognitive processing and behaviour.*

Stroop task involves two conflicting cues and one might expect that ACC is involved with the solution of this kind of task. The similar performance before hypnosis and during hypnosis suggests that the changes in activity did not improve the task performance but were somehow due to hypnotic induction.

*Remark:* Concerning TGD approach to hypnosis, the findings about PFC and ACC give important clues concerning the possible mechanism of hypnotic induction. The absence of specific neurological pattern reflecting “hypnotic trance” conforms with the idea that hypnosis involves something more than just brain. Instead of presence of specific EEG patterns one can expect the synchrony of EEGs of hypnotist and subject.

### 6.3 TGD View About Hypnosis

In the following TGD inspired ideas about hypnosis are discussed. The basic guideline is the observation that PFC and ACC seems to be the brain regions activated in Stroop task under hypnosis in the case of highly susceptible subjects. A more detailed view about functions of these brain areas suggests a picture about hypnosis as a kind of hijacking of the subject’s PFC and ACC by the magnetic body of the hypnotist so that the biological body and brain of the subject become to some extent part of the hypnotist. One could say that hypnosis represents one particular example of remote mental interactions in which remote control of personal biological body by magnetic body is extended to that of the foreign biological body.

Second key assumption is that imagined motor action is a halted motor action. This applies also to sensory imagination, which however involve a virtual sensory input from magnetic body to the primary sensory organs. In hypnosis hypnotist can prevent this halting action. A plausible candidate for the seat of the halting action is ACC which also is in some respects analogous to a lower level variant of PFC. This kind of analogy makes sense if brain is fractal like structure.

#### 6.3.1 Chevreul Pendulum As a way To End Up With The Model Of Hypnosis

My personal interest on hypnosis as a possible application of TGD inspired theory of consciousness was re-stimulated by an experience testing my susceptibility to hypnotic induction. My own expectation was that I would not be “an easy case”. The test was done by using improvised Chevreul pendulum. I held the pendulum at the height of my eyes. I received two kinds of suggestions. The first suggestion was a prediction that the pendulum will move. Second direct suggestion was “Don’t move the pendulum”. To my surprise the pendulum started to move and its amplitude grew gradually. I must admit that this looked like magic.

The first TGD inspired interpretation to come in mind was that the magnetic body of hypnotist hijacked some parts of my brain and used it to realize the suggestions given also verbally to increase their effectiveness. The discussion about the paradoxical outcome of “Don’t move the pendulum” led to the key ideas of the model.



1. Imagined motor action is realized as halted motor action - the negation of motor action: somehow this halting action should fail for hypnotic suggestions. In other words, the imagined motor action starts at high level, most naturally PFC and then proceeds downwards until it is halted in normal circumstance. By the duality relating motor action and sensory perception by time reversal (predicted by zero energy ontology [K19] ) similar mechanism should work at the level of sensory perception. Halting would involve inhibition of the neural signals otherwise propagating to muscles. The same failure of the halting mechanism would be behind dreams and hallucinations and automatisms as their motor counterparts.
2. Since ACC serves as a central station for top-down and bottom-up signals, ACC might be the place, where the halting signals are sent to various parts of motor cortex. Hence the catching of the attention of ACC so that it fails to perform its ordinary job would be the natural thing to do. This is achieved by generating flux tube connection binding ACC and some part of hypnotizers magnetic body to single quantum coherent system. ACC has also connections to PFC so that also PFC could be hijacked via ACC - at least in deep hypnosis.
3. ACC takes care of conflict situations and confusion as an effective method to induce hypnosis could be alternative to the eye fixation method. Confusion would induce distress inducing a contact with some magnetic body possibly providing help. This could be a basic mechanism in bicameral and schizophrenic consciousness in which “God’s voice” provides commands and advices. In the case of hypnotic induction the magnetic body of hypnotist would come in rescue. The activity of ACC would be a signature of conflict situation and could help in generating the connection.
4. The formation of flux tube connections could make the pendulum effectively a part of the biological body of the subject. This is nothing new: almost anyone knows that we feel bicycle or car effectively as our body part. Also illusions in which subject person identifies an external object as part of the biological body are created routinely. The command “Don’t move the pendulum” would be realized as a *motor command* “Move the pendulum” which would be usually halted but hypnotic induction would prevent this.

Some remarks about the relation to more general TGD based ideas about quantum biology and consciousness are in order.

1. The basic distinction between hijacking model and more standard models is that hypnosis is not single-brain phenomenon anymore. It would be interesting to see whether there is synchrony between the EEGs of hypnotists and subject in PFC and ACC and whether the synchronies between various brain regions could correlate with the nature of suggestions.
2. In this framework self-hypnosis would represent a situation in which some external magnetic body hijacks the brain of the person. This magnetic body could correspond to a layer of personal magnetic body or perhaps a magnetic body assignable to some collective level of consciousness as the model of bicameral and schizophrenic consciousness suggest.
3. Hypnosis can induce regression to childhood and is claimed to induce even memories about earlier lives. For instance, subjects manner to speak becomes childlike in this kind of state. Standard neuroscience does not allow beyond life memories but in TGD framework the situation remains open (for “Akashic records” view about memories see [K19] ). One can argue that a strong concentration to the suggestion might allow to become conscious about memories of childhood and even of previous lives.
4. Reconnection of flux tubes and phase transitions changing the effective value of Planck constant and therefore the length of flux tubes are basic mechanisms of TGD inspired quantum biology. Catching the attention of ACC would be as a mechanism very similar to its molecular counterpart in the TGD inspired model of homeopathic healing [K40]. In the latter case the attention of receptors at cell membrane is caught by an entity mimicking the invader molecule binding otherwise to the receptor. Hence most receptors bind to entities which do not cause the damaging effects produced by the invader molecules. Mimicry would be mimicry of cyclotron frequencies achieved by tuning the magnetic field strengths associated with the mimicking entity and at the same time making possible reconnection inducing flux tube connections and conscious attention at molecular level.

### 6.3.2 Hypnosis As Hijacking Of Foreign Biological Body

In the following I use hijacking as a metaphor for what could happen in hypnotic induction. A more positive manner to see the process would be as a voluntary sharing of brain with hypnotist's magnetic body. If one accepts TGD based view about remote mental interactions implying that personal magnetic body controls biological body by remote mental interactions, hypnosis represents a genuine example of remote mental interaction.

The model to be discussed assumes that hypnotist's magnetic body hijacks some parts of the subject's brain. The mind-dissociation model encourages to think that almost any brain region/function can be hijacked. One can however expect that there are some preferred brain regions: kind of central stations especially favorable and sensitive targets for high-jacking. In this respect important hints come from what are believed to be basic facts about functions of prefrontal cortex (see <http://tinyurl.com/642r4t>) (PFC) [J12] and anterior cingulate cortex (see <http://tinyurl.com/2yykqh>) (ACC) [J3], and from the observation that for highly susceptible subjects these regions demonstrate heightened activity during hypnosis during the performance of so called Stroop test.

#### Prefrontal cortex as target of hijacking

The general ideas of the hijacking model were already described. The following provides a more detailed discussion of the model (anyone with better background in neuroscience could probably add interesting details). The best strategy is to hijack the highest brain regions responsible for volition and control of motor and sensory imagination. Prefrontal cortex (PFC) is certainly an excellent candidate in this respect but it is not of course clear whether the direct hijacking of PFC is easy.

Prefrontal cortex (see <http://tinyurl.com/642r4t>) is the anterior part of frontal lobes lying in front of the motor and premotor areas. This brain region has been implicated in the planning complex cognitive behavior, personality expression, decision making, and moderating social behavior. One can also say that PFC carries executive function. This means cognition relating to control of cognition meaning thoughts/decisions about thoughts - imagination. Executive function relates to abilities to differentiate among conflicting thoughts, determine good and bad, better and best, same and different, future consequences of current activities, working toward a defined goal, prediction of outcomes, expectation based on actions, and social "control" (the ability to suppress urges that, if not suppressed, could lead to socially unacceptable outcomes). Clearly, PFC, the size of which also distinguishes between us and other primates, represents a very high if not the highest level of cognitive hierarchy unless one includes also the hierarchy of layers of the magnetic body.

A damage to frontal lobes can lead to loss of some of the listed functions, in particular to inability to make decisions so that also the patient has not lost his intellectual abilities and skills, he cannot do anything spontaneously but outsider must make the initiatives: this state brings in mind hypnotic state.

#### Anterior cingulate cortex as second target of hijacking

ACC (see <http://tinyurl.com/2yykqh>) is second brain area of primary interest. According to Wikipedia:

*ACC is the frontal part of the cingulate cortex, which resembles a “collar” surrounding the frontal part of the corpus callosum. It consists of Brodmann areas 24, 32, and 33. It appears to play a role in a wide variety of autonomic functions, such as regulating blood pressure and heart rate, as well as rational cognitive functions, such as reward anticipation, decision-making, empathy, impulse control, and emotion.*

*The anterior cingulate cortex can be divided anatomically based on cognitive (dorsal), and emotional (ventral) components. The dorsal part of the ACC is connected with the prefrontal cortex and parietal cortex as well as the motor system and the frontal eye fields making it a central station for processing top-down and bottom-up stimuli and assigning appropriate control to other areas in the brain. By contrast, the ventral part of the ACC is connected with amygdala, nucleus accumbens, hypothalamus, and anterior insula, and is involved in assessing the salience of emotion and motivational information. The ACC seems to be especially involved when effort is needed to carry out a task such as in early learning and problem-solving.*

*On a cellular level, the ACC is unique in its abundance of specialized neurons called spindle cells (see <http://tinyurl.com/yamxmwej>) [J13]. These cells are a relatively recent occurrence in evolutionary terms (found only in humans and other great apes, cetaceans, and elephants) and contribute to this brain region’s emphasis on addressing difficult problems, as well as the pathologies related to the ACC.*

A typical task that activates the ACC involves induction of some form of conflict within the subject that can potentially result in an error. Stroop task represents one such task and activates the ACC of highly susceptible subjects more strongly during hypnosis. In Stroop task the person must name the color of the ink of words that are either congruent or in-congruent (the color of the word RED is red or blue). The conflict occurs since the color or the written word is in conflict with the meaning of the word. Erickson’s methods use confusion as a means of inducing hypnosis. This suggests that the activation of ACC by confusion is essential for hypnotic induction.

Error detection, anticipation of tasks, attention, motivation, and modulation of emotional responses are functions assigned with the ACC. Deep focusing of attention is indeed essential for hypnosis. The fact that frontal eye fields representing unconscious-to-us fast visual pathway initiating of eye movements such as voluntary saccades, pursuit eye movements and its connection to ACC suggests that the pendulum catches the attention of ACC in the Chevreul test. The fact that prefrontal lobes are connected to ACC suggests that hijacking of PFC could take place via ACC.

Francis Crick identifies ACC as a possible locus free will. In TGD framework this kind of identification is too strong. One might however consider the possibility that ACC is the part of brain halting the motor imagination proceeding as cortical activity downwards and prevents it from transforming to a genuine motor action. Volition might be quite generally halting or non-halting of imagined motor action. By the time reversal symmetry relating motor action and sensory perception in TGD framework, ACC would play similar role for sensory perception. Note that the selection between sensory percepts associated with bin-ocular rivalry could be understood in terms of time reversed volition. The role of ACC as central station for bottom-up and top-down stimuli would conform with this view.

*Remarks:*

1. One can imagine two kinds of stimuli: the motor stimuli initiated at frontal lobes originally as imagination and possibly halted by ACC and simple motor stimuli initiated by ACC respectively proceeding directly to motor organs via premotor cortex. In the similar manner one can image sensory stimuli received by ACC and not proceeding to upper levels and those proceeding to higher levels and sensory stimuli proceeding up to PFC.
2. This division could roughly correspond to “slow” and “fast” (unconscious-to-us) sensory and motor pathways. Freud’s super-ego-ego-Id hierarchy might in turn relate to magnetic body-PFC-ACC division. The interpretation of ACC as a primitive analog of PFC would also conform with the role of ACC in early learning. Hijacking of ACC first by redirecting its attention - to say pendulum - so that it cannot take care of some of its basic functions, could be part of hypnotic induction.

Why the activation of ACC should promote the hypnotic induction? The activation could be a neural correlate for confusion, which puts the person to the same position in which bicameral according to Jaynes was and schizophrenic is often. In this kind of situation some higher layer of the personal magnetic body could come in rescue. The generation of reconnections requires that ACC performs “magnetic motor activity” modulating the thickness of the flux tubes of its magnetic body (tuning the value of magnetic field to be the same as that of the hoped for helper) and perhaps also moving the flux tubes to achieve the desired reconnection. In the case of hypnosis the reconnection of between the magnetic bodies of ACC and hypnotist would take place. If ACC is responsible for “Don’t” function then catching the ACC’s attention by hypnotic induction or confusing it would allow the imagined motor actions and sensory perceptions to become real and hypnotic suggestions could be realized.

### 6.3.3 Preconscious Mechanism Of Hypnotically Altered Colors

I learned recently about very interesting work on hypnosis by finnish researchers Mika Koivisto, Svetlana Kirjanen, Antti Revonsuo and Sakari Kallio. The article “A Preconscious Neural Mechanism of Hypnotically Altered Colors: A Double Case Study” is published in journal Plos ONE [J44] and is available at <http://tinyurl.com/ydzbc43q>.

Here is the abstract of the article:

*Hypnotic suggestions may change the perceived color of objects. Given that chromatic stimulus information is processed rapidly and automatically by the visual system, how can hypnotic suggestions affect perceived colors in a seemingly immediate fashion? We studied the mechanisms of such color alterations by measuring electroencephalography in two highly suggestible participants as they perceived briefly presented visual shapes under posthypnotic color alternation suggestions such as “all the squares are blue”. One participant consistently reported seeing the suggested colors. Her reports correlated with enhanced evoked upper beta-band activity (22 Hz) 70–120 ms after stimulus in response to the shapes mentioned in the suggestion. This effect was not observed in a control condition where the participants merely tried to simulate the effects of the suggestion on behavior. The second participant neither reported color alterations nor showed the evoked beta activity, although her subjective experience and event-related potentials were changed by the suggestions. The results indicate a preconscious mechanism that first compares early visual input with a memory representation of the suggestion and consequently triggers the color alteration process in response to the objects specified by the suggestion. Conscious color experience is not purely the result of bottom-up processing but it can be modulated, at least in some individuals, by top-down factors such as hypnotic suggestions.*

According to the announcement of finnish academy, the results challenge the existing theories of hypnosis. This work represents a model of hypnosis as one particular instance of remote mental interactions on basis of TGD inspired quantum theory of consciousness. Quantum entanglement between parts of separate brains, the notion of magnetic body, and TGD based view about sensory organs play key roles in the model. In TGD framework the primary qualia are at the level of sensory organs and sensory representations involve a feedback from magnetic body via brain to sensory organs in terms of dark photons so that the sensory percepts consist of standardized mental images - being more like an artworks emphasizing important features rather than a faithful representation of reality.

The findings of about hypnosis can be used also to test the proposed view about hypnosis. As the abstract concludes, color experience is not purely the result of bottom-up processing but can be modulated by top-down factors. In TGD framework this reflects the basic difference between standard neuroscience and TGD deriving from two assumptions.

- Sensory organs are carriers of primary qualia - the phenomenal experience.
- Brain is manufacturer of sensory and memory representations decomposing perceptive field to standardized mental images representing objects and naming them. Virtual sensory input is used to achieve this.

In the experiments the form-color correlation created by hypnotic suggestion could be in conflict with the real visual input. The other subject person sensitive to hypnosis managed to transform the real color percept to a percept consistent with the suggestion. The other subject person also sensitive to hypnotic suggestions reported that his/her eyes and brain “saw” different colors.

In TGD Universe the interpretation would be that magnetic body and brain below it in the self hierarchy imagined the correlation consistent with the suggested one in both case. The imagined color was produced by a virtual sensory input realized as dark photons propagating down from magnetic body to cortex and to the lower levels of brain. This applies to imagination in general. For the sensory imagination the propagation halts before reaching sensory organ - now retina. For hallucinations this halting does not happen. Hypnotic suggestion can prevent this halting so that imagined color transforms to a hallucinated color. This happened for the first subject in the experiments. The second subject experienced both the real color and possibly conflicting imagined color associated with the virtual sensory input halting to some higher level in brain between visual cortex and retina. Note that this serves as evidence for the notion of self hierarchy, which is a basic prediction of TGD inspired theory of consciousness.

Also a comment about time scales involved is in order. The peak in the EEG of the person, who experienced the suggested color-shape correlation appeared after an average time of  $T = .1$  seconds from the visual input.  $T$  corresponds to 10 Hz fundamental bio-rhythm and the chronon of sensory experience. In TGD framework  $T$  characterizes the scale of causal diamond (CD) defining the spotlight of consciousness assignable also to sensory percepts. That  $T$  is also the secondary p-adic length scale assigned with electron in TGD conforms with the proposal that electron Cooper pairs play a central role in sensory perception. Primary and secondary p-adic length and time scales (the latter are macroscopic) characterizing elementary particles represents new physics predicted by TGD.  $R = .05$  seconds corresponds to distance  $R = cT = 15$  Mm, which is more than twice the radius of Earth equal to 6.4 Mm. Hence a signal propagating with velocity of light could travel to a layer of magnetic body with this size and back during time.1 seconds.

After having received the announcement of Finnish academy and before seeing the abstract of the article, my own guess was that the high-frequency EEG refers to 40 Hz thalamo-cortical resonance studied by Antti Revonsuo - one of the authors of the recent work. I was wrong. What Revonsuo found was that 40 Hz resonance does *not* serve as a correlate of mental image as conjectured by Crick and Koch but for the emergence of a new mental image. What was studied was a situation in which the subject person experienced the emergence of 3-D geometric pattern from a chaotic set of dots and lines. 40 Hz activity accompanied only the eureka period: a possible TGD inspired interpretation is that the direct eureka experience was transformed to a memory, which did not generate 40 Hz activity. The 20 Hz activity involved with the change of the perceived color to the suggested color would also correspond to similar re-organization of the perceptive field induced by virtual sensory input masking the real one. What is interesting is that 10, 20, 40, 80 Hz frequencies appear as resonances in EEG (see <http://tinyurl.com/yaa5xyo5>) and that they are octaves of 10 Hz. TGD indeed strongly suggests that preferred CD scales come as octaves. Primary p-adic length scales in turn would come as half octaves.

### 6.3.4 Chi Energy - master gets animals to sleep

In Facebook I encountered an interesting a video with the title “Chi Energy - master gets animals to sleep” (see <http://tinyurl.com/hvfk4nv>). The video was very impressive and I recommend seeing it. Below I propose an explanation for the feats of the master.

I have constructed a theory of remote mental interactions but always said that I do not believe in them - I just take their possibility very seriously. To be honest, the only reason for this attitude is that they emerge naturally from TGD inspired theory of consciousness. This video made me a believer. I know that skeptic “knows” that the video is hoax and demands 10 sigma statistical proof that every chi master in every corner of the Universe can put animals to sleep under controlled laboratory conditions by weaving his hands. It does not matter: we can laugh together to my gullibility if this helps skeptic to avoid despair in his intellectual isolation.

We had a long discussion about the video and Ulla noticed the similarity with hypnosis: even the word “hypnosis” originally means some kind of sleep like state. In TGD framework hypnosis could be seen as a particular example of remote mental interactions. Simplifying: hypnotizer would

in some sense hijack some part of brain of the subject by quantum entangling with it so that it becomes part of hypnotizer and obeys his commands. Note that the social explanation of hypnosis as the desire of subject to please the hypnotiser does not explain what happens to the animals.

In the discussion consciousness was of course mentioned and consciousness was compared to field. As a philosophically oriented physicist I get worried when one says "consciousness is a field" or something like that. I would prefer to speak about field patterns as correlates for contents of consciousness. To me consciousness itself is an independent form of existence not reducing to a property of physical system as materialist believes. This looks like pedantry but becomes absolutely crucial if one really wants to understand consciousness. Real progress in science is mostly getting rid of sloppy language implying sloppy thinking.

I have explained so many times the basic ideas of TGD inspired theory of consciousness (call it TTC for short) and I am afraid that most readers have not got the message. I think that independently rediscovering TTC is the only manner to realize what I am trying to say. Therefore only few paragraphs.

One needs a new ontology - a vision about what exists. This ontology is neither materialistic nor dualistic and in which consciousness is not a property of physical state as "-ness" would suggest but resides in the nowhere-nowhen-land between two quantum states replaced with analogs of quantum evolutions of Schrödinger equation. I call the new ontology Zero Energy Ontology (ZEO) and it leads to a new view about quantum measurement theory and state function reduction giving theory of consciousness as by-product by transforming observer from an outsider to the Universe a part of quantum physics. Conscious entity is the outcome of Zeno effect - a sequence of state function reductions which would not change the state in standard ontology at all but gives rise to the experienced flow of time in ZEO.

A lot of unexpected predictions follow. Mention only the possibility of exotic unexpected phenomena such as time reversed consciousness, the re-incarnation of conscious entity in different time after biological death, and the predicted hierarchy of conscious entities with mental images identifiable as sub-selves - conscious entities. Also a detailed view about quantum biology and about remote mental interactions emerges.

Quantum biology involves a generalization of both classical physics and quantum physics.

1. Classical physics is generalized by replacing space-time with space-time surfaces bringing in notions like many-sheeted space-time, magnetic flux quanta/tubes, field body and topological light rays essential for understanding living matter. Magnetic body (MB) becomes what might be called intentional agent. Our MB is the "real us" using our biological body (BB) as a motor instrument and sensory receptor. EEG and its scaled variants mediate sensory information from neuronal/cell membranes to parts of magnetic body having onion-like structure and control commands from MB to genome initiating gene expressions and possible other hitherto unknown genome related functions such as topological quantum computation and communications with dark photons which decay to bio-photons.

Magnetic flux tubes accompany and are space-time correlates of entanglement: note that also superstringers have ended up with this idea but talk about wormholes instead of flux tubes.

Concerning remote mental interactions, the crucial difference from Maxwell's linear and relatively simple theory is that flux tubes make possible precisely targeted communications such that the signal does not weaken with distance. This is like replacing radio station with something sending laser signals along cable: replacing mass communication like radio broadcast with email. The signals - I call them topological light rays - are analogous to laser light beams travelling along flux tubes: also their existence distinguishes TGD from Maxwell's theory where light signals travel in all directions and weaken like  $1/r^2$ .

2. The generalization of quantum physics involves the hierarchy of Planck constants coming as multiples of ordinary Planck constants and identified in terms of dark matter which becomes a key player in living systems. Scaling of Planck constant scales up quantum lengths and gives rise to macroscopic quantum coherence, which is the key property of living matter. p-Adic physics and fusion of real physics (correlates of sensory experience) and various p-adic physics (correlates of cognition and imagination) is an essential element of the theory too.

Consider now what remote mental interactions might be.

1. Attention is obviously an essential element. This master intensively attends. Magnetic flux tubes are correlates for attention. When I attend something the flux tubes connecting some part of me to this something are formed. This something could be mental image perhaps localizable to my brain or an object of external world - say my cat. Or the animals in the amazing video, which motivated the writing of this posting. Magnetic flux tubes are like tentacles studying the environment and when they find tentacle of another BB, reconnection to a bridge connecting the biological bodies can happen if the magnetic field strengths are nearly the same. This implies that cyclotron frequencies are same so that the reconnection involves resonance.

This is a good reason to identify the prerequisites/correlates for remote mental interactions as magnetic flux tubes, which are TGD counterparts of Maxwellian magnetic fields but differ from them since they are topologically quantized.

2. Remote mental interactions are not anything exotic in this world view: the communications from BB and control of my BB by my MB rely on remote mental interactions. What we are used to call remote mental interactions is the same phenomenon except that the target is not my BB but something else: say patient in remote healing or computer in experiments testing whether intention can affect random number generator.

What might happen in the video?

1. What could happen as the master in the video weaves his hands? Same as in hypnosis, which is also a remote mental interactions. The magnetic flux tubes for a part of hypnotizer's MB reconnect with those for a part of subject's MB fusing two conscious entities single one with chi master serving as boss for the unit formed in this manner. Both supra currents and analogs of laser light signals can proceed along these bridges thus formed. This is the same effect as the fusion of mental images - subselves - producing stereo vision. Fusion can occur also for mental images in different brains: our consciousness is not so private as we think - be cautious with your thoughts;-). Your brain children are not always only your brain children!
2. What makes a fellow who just weaves his hands "superhuman" - as the video says? How the movement of his hands can have so magic effect? It cannot. MB acting as an intentional agent is needed. The skills of the master in using his MB give him his magic looking powers - he is a master in magnetic gymnastics;-). Yoga trains your BB, meditation trains your MB. Using the tentacles emanating from his hands the master can get a contact even to the MBs of members of different species and make them part of this own MB and give commands to them. As the master weaves his hands he helps the flux tubes to form reconnections with the MBs of the subject animals. I wonder whether the master can "see" the flux tubes of foreign magnetic bodies (not necessarily consciously at his level of self hierarchy). This would make his task much easier.

## Chapter 7

# Meditation, Mind-Body Medicine and Placebo: TGD point of view

### 7.1 Introduction

The chapter represents TGD inspired answers to Lian Sidorov's questions concerning meditation, mind-body medicine and placebo in quantum biology framework. To help the reader, some aspects of TGD inspired theory of consciousness and quantum biology are summarized since several new insights inspired by the notions of magnetic body and dark matter have emerged lately. This includes improved views about quantum metabolism and prebiotic life: the basic input comes from the claimed free energy phenomena interpreted in TGD framework. Water structures representing simplified analogs of basic biomolecules suggested by water splitting producing so called Brown's gas might be highly relevant also for the ordinary metabolism. The main new input concerning remote mental interactions comes from a possible answer to the question whether TGD based ontology of physics could allow the "shamanistic" view that the experiences (say encounters with strange life forms assigned with distant civilizations) induced by various psychedelics used in the spiritual practices of indigenous people could be genuine remote sensory perceptions rather than hallucinations. Affirmative answer would mean a direct and testable connection between neuropharmacology and remote sensory perception with serotonin defining the crucial neurotransmitter and pineal gland ("third eye") serving as a candidate for the brain area of special importance in this respect.

Concerning the questions about meditation, mind-body medicine and placebo, the key concept is that of magnetic body. Usually organism and environment are seen as members of an interacting pair: organism receives sensory data from environment and controls it. Now magnetic body appears as a third party, "intentional agent" using biological body as a kind of interface between magnetic body and environment. Various "motor actions" of the magnetic body are highly relevant for both consciousness and biochemistry. The pairs formed by various information molecules and corresponding receptors could define plug-ins to the Indra's net (or Internet) defined by the magnetic bodies and Josephson radiation emitted by Josephson currents assignable to receptors would propagate along flux tubes. Meditation can be seen as "bodily exercise" of the magnetic body and a method to improve the communications between magnetic body and biological body. In healing magnetic body would be the active participant and healing would be also the healing of magnetic body. The placebo effect could be seen as an outcome of intentions of magnetic body affecting biological body.

The change of gene expression in meditation could be understood in terms of magnetic body. Genetic expression would be naturally determined by the permanent flux tube connections from the magnetic body to the promoter portions of DNA. Differentiation would select the promoters to which the magnetic body has permanent connections. The change of gene expression could be due to a change of these connections. Both meditation, placebo effect, and healing could induce changes in gene expression in this way.

The appendix of the book gives a summary about basic concepts of TGD with illustrations. Pdf representation of same files serving as a kind of glossary can be found at <http://tgdtheory>.



fi/tgdglossary.pdf [L15].

## 7.2 Brief Summary About TGD Based Vision About Life And Consciousness

### 7.2.1 Magnetic And Electric Bodies

The notion of “magnetic body” has become more and more central concept in TGD inspired theory of quantum biology. Also electric fields are fundamental in living matter consisting of electrets and one could speak about electric bodies too. The notion of field body is possible only in TGD framework where space-times are 4-surfaces of 8-dimensional space  $M^4 \times CP_2$  and various classical fields are geometrized in terms of geometry and spinor structure induced from those of embedding space.

One can assign to any physical system magnetic body (or more generally field body), which consists of space-time sheets representing field quanta of magnetic and electric fields geometrically: typically they have the shape of flux tube or flux sheets. Of special importance are flux tubes carrying monopole Kähler magnetic flux - as if there would be magnetic monopole serving as the source of the magnetic field. There are however known magnetic monopoles in TGD Universe. These flux tubes are in fundamental role in the description of elementary particles and very probably also the magnetic flux tubes relevant for living matter carry monopole fluxes: even magnetic field associated with permanent magnets could involve monopole flux tubes, whose characteristic property is that there is no current creating the field. In cosmology this kind of fields are present in all scales and the mystery in the standard physics framework is caused by the fact that permanent currents in this scales are not possible.

The topological dynamics of magnetic flux tubes is based on reconnection process creating and modifying the topology of the web of magnetic flux tubes. In living matter this web is assumed to be responsible for the coherent behavior of living organisms. The reconnection building a double flux tube bridge between two systems is assumed to define the space-time correlate for the generation of directed attention. Second important piece of dynamics is the change of the length of the magnetic flux tube induced by the change of  $h_{eff}/h$ . The shortening of flux tubes connecting distant biomolecules would force them near each other and make possible selective bio-catalysis. This mechanism should be crucial for DNA replication and transcription, and mRNA translation.

Also the dark matter at magnetic flux tubes is assumed to be essential element of what it is to be living. Dark matter hierarchy corresponds to a hierarchy of effective values of Planck constant given by  $h_{eff}/h = n$ . Cyclotron frequencies for charged bosons and Cooper pairs of charged fermions could be carriers of metabolic energy realized as cyclotron energy which is large for large values of  $n$ .

One can of course also speak about electric bodies - living matter is full of electrets and already Fröhlich realized the importance of electric fields - and cell membrane would define a fundamental system of this kind. The flux tubes connecting the interior and exterior of membrane would carry electric voltage in the stationary case and in super-conducting situation oscillating Josephson currents generating dark Josephson radiation at frequency  $f_J = ZeV/h_{eff}$  are present. EEG - or rather hierarchy of dark EEGs at various frequency scales but with same energies actually assignable to bio-photons - could correspond to this radiation and dark cyclotron radiation. They would mediate communication of sensory data to the magnetic body and control commands from the magnetic body.

### 7.2.2 Frequency Coding And Targeted Attention

Dark photons are also an important piece of the bio-puzzle. Microscopically they correspond worm-hole contact pairs connecting to “massless extremals” (MEs) (as a matter of fact, all elementary particles have this kind of identification). Dark photons would be generated as Josephson photons and cyclotron photons. The simplest assumption is that standard mechanisms of biochemistry generate only ordinary photons. The basic property of dark photons is that the energy for a given frequency is scaled up by factor  $h_{eff}/h$  so that ELF radiation can correspond to energies of even

visible photons as would indeed do if EEG corresponds to dark photons having energies if visible and perhaps even UV photons.

1. If the photons are absorbed resonantly, photons frequencies serve as analogs of passwords so that living matter would apply the analog of radio communications for dark photons. Given part of living system in given scale would be characterized by photon frequency which by p-adic length scale hypothesis would correspond to a power of two. A collection of these frequencies coming as powers of two would effectively define a sequence of binary digits specifying the p-adic space-time sheet of the receiver. This coding mechanism could be at work not only inside organism but also between different organisms. The magnetic bodies have astrophysical dimensions and in principle there is no limit for the scales involved. Directed attention would correspond to reconnection of magnetic flux tubes implying common cyclotron frequency spectrum plus cyclotron transitions induced by the radiation transferred between the participants.

Frequencies serving as passwords would make possible precisely targeted communications if receiver frequencies vary as a function of position. Cyclotron radiation along massless extremals parallel to magnetic flux tubes serving as kind of waveguides achieves the same. These two mechanisms could be actually one and same.

2. Zero energy ontology in turn strongly suggests communications based on reflections in time direction at the opposite boundaries of causal diamonds (CDs) having interpretation in terms of state function reductions. This allows to speculate about communications in cosmic scales taking place instantaneously with respect to subjective time. It is not clear whether the standard view about causality based on unique direction of geometric time denies this possibility.
3. Very probably frequency alone is not all that is involved. Just as in the ordinary radio communications, the signal itself could be coded by amplitude or frequency modulation of the carrier frequency. One of the possible mechanisms generating dark photons would be amplitude modulation. Frequency modulation could be realized as variation of Josephson frequency induced by that of membrane potential and cell membranes indeed carry membrane potential waves besides nerve pulses. Cyclotron frequency could be modulated by oscillations of the flux tube thickness induced the variation of magnetic field strength forced by the flux conservation.

There is evidence that a process interpreted as a propagation of bio-photons along neural fibers takes place. In TGD framework this would correspond to the propagation of dark photons along magnetic flux tubes parallel to the fibers. I have proposed that magnetic flux tubes assignable to neural pathways (and also meridians of acupuncture system) serve as analogs wave guides for dark photons. If sensory organs are really the seats of the fundamental sensory experiences and brain builds cognitive representations by analyzing the sensory input and decomposing it to objects with names as TGD suggests [K37], then the feedback from brain and even magnetic body is needed in order to build the sensory representations as kind of art works. This would explain dreams (REM) and hallucinations as being caused by virtual sensory input from the magnetic body (maybe induced by sensory input to magnetic body even from some other magnetic body as in case of remote mental interactions).

### 7.2.3 Meditation And Magnetic Body

One manner to see meditation is as a method to develop ability to precisely targeted attention by getting rid of all perturbing mental images. If one accepts that reconnections for the flux tubes of the magnetic body are crucial for the targeted attention and that the  $h_{eff}$  serves as a kind of universal quotient of spiritual intelligence, the conclusion would be that meditation means practices for developing maximally flexible magnetic body able to build rapidly contacts with higher levels of the personal magnetic body and also with other magnetic bodies. Meditator would be a master of magnetic motor actions whereas yogi would be a master of motor actions of biological body. If healing involves connection between magnetic bodies or magnetic body and biological body of healee, meditation should help also to achieve healing abilities.

In biology everything seems to obey engineering standards and the build-up of connections to other magnetic bodies need not be an exception to the rule. Various information molecules and corresponding receptors would indeed define natural candidates for the plugs connecting brain and body to the magnetic Indra's net. Therefore meditative practices should develop the ability to control the levels of various information molecules and receptors in body.

## 7.3 NMP, Hierarchy Of Planck Constants, P-Adic Length Scale Hypothesis And Negentropic Entanglement

Around the year 2003 a number of new ideas emerged simultaneously. Learning about hyperfinite factors of type  $II_1$  and their inclusions [K109] lead to a proposal for the mathematical description of finite measurement resolution and cognitive resolution. Also the idea about hierarchy of Planck constants allowing to identify dark matter as phases of ordinary matter, and the notion of negentropic entanglement emerged and led to a lot of speculation. Over the years connections between these notions and vision about their more detailed realization have emerged. One can say that NMP, hierarchy of Planck constants, p-adic length scale hypothesis, negentropic entanglement, and even inclusions of hyperfinite factors are very intimately related. Of course, all of this is just a highly entertaining intellectual game - very much like solving a crossword puzzle - and only time and experiment will show whether it has anything to with reality.

### 7.3.1 Negentropic Entanglement And Hierarchy Of Planck Constants

The hierarchy of Planck constants makes possible negentropic entanglement (see **Fig.** <http://tgdtheory.fi/appfigures/cat.jpg> or **Fig. ??** in the appendix of this book) and genuine information represented as negentropic entanglement in which superposed state pairs have interpretation as incidences  $a_i \leftrightarrow b_i$  of a rule  $A \leftrightarrow B$ : apart from possible phase the entanglement coefficients have same value  $1/\sqrt{n}$ , where  $n = h_{eff}/h$  define the value of effective Planck constant and dimension for the effective covering of embedding space. This picture generalizes also to the case of multipartite entanglement but predicts similar maximal entanglement for all divisions of the system to two parts. There are however still some questions which are not completely settled and leave some room for imagination.

1. Negentropic entanglement is possible in the discrete degrees of freedom assignable to the  $n$ -fold covering of embedding space allowing to describe situation formally. For  $h_{eff}/h = n$  one can introduce  $SU(n)$  as dynamical symmetry group and require that  $n$ -particle states are singlets under  $SU(n)$ .  $SU(n)$  brings in mind the dynamical gauge symmetry group introduced earlier for inclusions of hyper-finite factors of type  $II_1$  [K109] to which one can assign simply laced Lie groups such as  $SU(n)$  by Mac Kay correspondence [A2]. I proposed these groups as effective gauge group making possible emulation of all possible gauge group dynamics so that TGD Universe would be like Turing machine able to mimic any mathematically consistent dynamics. The inclusions would also characterize the finite measurement resolution: the states created by the included algebra would create states not distinguishable from each other in the resolution used.

This gives rise to  $n$ -particle states constructed by contracting product of some number  $k$  of  $n$ -dimensional permutation symbols contracted with many particle states assignable to  $m$  factors. These states would generalize  $k$ -particle states. For  $k = 1$  and  $m > 1$  one would have single particle state in "schizophrenic state" consisting of  $m$  particles with fractional quantum numbers  $n_i/n$  times the usual quantum numbers. Spin-statistics connection might produce problems - at least it is non-trivial - since one possible interpretation is that the states carry fractional quantum numbers - in particular fractional fermion number and charges.

These strange states with completely unique form would generalize the notion of N-atom proposed for decade ago as giving emergence of symbols and "sex" at molecular level [K28]. The status of this idea has remained very uncertain but I have not been able to throw it to paper basked. The second quantization associated with the finite coverings of embedding space would give rise to the negentropic entanglement, symbolic dynamics, and also to "Akashic

records” as almost invariants of the quantum jump sequence (thanks to their negentropic resources respected by NMP). “Molecular sex” means that all states can be seen as composites of two states with opposite fractional  $SU(n)$  quantum numbers (this decomposition need not be unique!). This brings in mind the monogamy theorem for ordinary entanglement stating that maximal entanglement means this kind of decomposition to two parts.

2. While writing this I realized that the question whether negentropic entanglement is possible only in the new covering degrees of freedom or also in more familiar angular momentum, electroweak, and color degrees of freedom, remains open [K52]. The latter states are especially interesting biologically and from the point of view of photosynthesis and navigation of birds if one believes on the proposed explanations: long-lived negentropically entangled spin singlet electron-hole pairs and electron pairs are proposed as explanation of the experimental findings. If only the covering degrees of freedom are involved the entanglement stable against thermal perturbations is in these degrees of freedom.

### 7.3.2 NMP And Evolution Of Intelligence

Alexander Wissner-Gross, a physicist at Harvard University and the Massachusetts Institute of Technology, and Cameron Freer, a mathematician at the University of Hawaii at Manoa, have developed a theory that they say describes many intelligent or cognitive behaviors, such as upright walking and tool use [J26, J88]. The basic idea of the theory is that intelligent system collects information about large number of histories and preserves it. Thermodynamically this means large entropy so that the evolution of intelligence would be rather paradoxically evolution of highly entropic systems. According to standard view about Shannon entropy transformation of entropy to information (or the reduction of entropy to zero) requires a process selecting one of instances of thermal ensemble with a large number of degenerate states and one can wonder what is this selection process. This sounds almost like a paradox unless one accepts the existence of this process. I have considered the core of this almost paradox in TGD framework already earlier.

According to the popular article (<http://tinyurl.com/cb9p8we>) the model does not require explicit specification of intelligent behavior and the intelligent behavior relies on “causal entropic forces” (here one can counter argue that the selection process is necessary if one wants information gain). The theory requires that the system is able to collect information and predict future histories very quickly.

The prediction of future histories is one of the basic characters of life in TGD Universe made possible by zero energy ontology (ZEO) predicting that the thermodynamical arrow of geometric time is opposite for the quantum jumps reducing the zero energy state at upper and lower boundaries of causal diamond (CD) respectively. This prediction means quite a dramatic deviation from standard thermodynamics but is consistent with the notion of syntropy introduced by Italian theoretical physicist Fantappie already for more than half a century ago as well as with the reversed time arrow of dissipation appearing often in living matter.

Negentropy Maximization Principle (NMP) resolves also the above mentioned almost paradox (at least). I have proposed analogous principle but relying on generation of negentropic entanglement and replacing entropy with number theoretic negentropy obeying modification of Shannon formula involving p-adic norm in the logarithm  $\log(p)$  of probability. The formula makes sense for probabilities, which are rational or in algebraic extension of rational numbers and requires that the system is in the intersection of real and p-adic worlds. The dark matter matter with integer value of Planck constant and  $h_{eff} = nh$  predicts rational entanglement probabilities: their values are simply  $p_i = 1/n$  since the entanglement coefficients define a diagonal matrix proportional to unit matrix. Negentropic entanglement makes sense also for n-particle systems as found and the form of the states is essentially unique.

Negentropic entanglement corresponds therefore always to  $n \times n$  density matrix proportional to unit matrix: this means maximal entanglement and maximal number theoretic entanglement negentropy for two entangled systems with number  $n$  of entangled states.  $n$  corresponds to Planck constant  $h_{eff} = n \times h$  so that a connection with hierarchy of Planck constants is also obtained. Power of the p-adic prime by definition defines largest prime power divisor of  $n$ . Individually negentropically entangled systems would be very entropic since there would be  $n$  energy degenerate states with same Boltzmann weight. Negentropic entanglement changes the situation: thermodynamics

of course does not apply anymore. Hence TGD produces same prediction as thermodynamical model but avoids paradox.

### 7.3.3 How To Produce Dark Matter

If one wants to test the vision about dark matter, one must be able to manipulate and even produce it. I have considered several mechanisms for producing dark matter. It must be emphasized that the ideas are yet at rather heuristic level.

1. Modulation of high frequency radiation by low frequency radiation such that the ratio of the frequencies is integer, call it  $n$ , characterizing the effective Planck constant  $h_{eff}/h = n$  is one proposal inspired by experimental findings of Cyril Smith related to water memory [I11]. Smith suggests that one particular ratio  $n \simeq 2 \times 10^{11}$  is of special importance. Number theoretical simplicity and p-adic length scale hypothesis suggest Fermat integers - are products of distinct Fermat primes and powers of two - as good candidates for  $n$ . One could perhaps say that ordinary higher frequency photons is replaced with a bundles of  $n$  fractional photons with energy and frequency divided by  $n$ . At the level of space-time and embedding space geometry this means the emergence of effective  $n$ -fold covering. The extreme non-linearity of Kähler action could give rise to these  $n$ -furcations.
2. The presence of strong electric fields and voltages and plasma phase seem to generate effects having explanation in terms of the hierarchy of Planck constants. In particular, di-electric breakdown seems to be involved. For instance, cell membrane characterized by the presence of extremely strong electric field. Plasmoids as lifeforms would also involve strong electric fields. Also magnetic fields seem to be essential. Splitting of water in electrolysis using strong electric fields (“peaky” electrodes) involves also strong electric fields and generates Brown’s gas having anomalous properties. One could argue that the presence of strong electric fields is what leads to the generation of  $n$ -furcations at the level of space-time dynamics.
3. The latest proposal is based on some input from observations related to free energy leading to the observation that the quantum mechanical description of a system to which constant torque is applied leads to mathematical problems in the framework of standard quantum theory solved by introducing  $n$ -fold covering space of circle, hierarchy of Planck constants, and zero energy ontology [K44]. The value of  $n$  is at least the number of turns made by the rotating system during the time the torque is applied. This mechanism would explain why the values of  $n$  are so large. Constant torque represents an example of an open system driven by external generalized forces and living systems are systems of this kind. Formally the system is conservative but the potential function is either many-valued or discontinuous at  $2\pi$  and this forces to introduce the covering space if one wants to describe rotating and accelerating wave packets. Note also that the force can be arbitrarily small so that there is instability against generation of higher values of  $h_{eff}$ . What is of special interest is that ATP synthase (<http://tinyurl.com/y8xu5nto> ) involves generator with a rotating shaft (just like an electric power plant) and therefore also a torque to compensate for dissipative losses. Is its purpose to generate large  $h_{eff}$  phase?

Note that cavitation is one manner to generate water splitting and associated charged water clusters and plasmoids: it is typically produced by a rotating shaft. Does this mean that turbulent water could have served as a seat for primordial life forms? Note that in homeopathy mechanical agitation is applied to the diluted sample: the proposed interpretation has been that this drives the replication and evolution of dark life forms defined by dark nucleon sequences [K40].

### 7.3.4 Dark Proton Sequences, Genetic Code, And Primordial Life Forms

The general strategy should be simple. One starts from experimental facts and explains them in terms of TGD allowing free imagination and trying to achieve internal consistency between different ideas [K44].

1. The old result is that I cannot avoid mentioning again and again is that in atto-second scale water obeys stoichiometry  $H_{1.5}O$  as if 1/4: th of hydrogens were dark and thus not visible in electron scattering and neutron diffraction. This fact can be found from Chaplin's homepage (<http://tinyurl.com/ye77f7d>) devoted to water and containing impressive list of anomalies related to the physics of water. This finding was one of the original motivations for introducing hierarchy of Planck constants.

I introduced dark nuclei identified as sequences of dark hydrogens/protons as explanation of the strange stoichiometry and also for the anomalies: there would be two phases (at least, not the  $h_{eff}$  can have several values) present and this makes the behavior of water more complex. Dark nuclei are strings of dark protons connected by color bonds. The size scale of nucleus is scaled up by  $h_{eff}$  and would be about atomic scale: atto-second multiplied by  $c$  gives this scale.

The really big surprise was that the model for dark proton led directly to the realisation of vertebrate genetic code [K56, K40]: the states of dark proton can be naturally arranged to groups corresponding to DNA, RNA, amino acids, and remaining states whose number is smaller than 64 which I tentatively identify in terms of tRNA. Genetic code is obtained if states in different groups are identified by requiring that states corresponding to each other have same total quark spin and same spin assignable with the flux tube (two colour bonds connecting quarks).

In TGD framework this relates also to the understanding of water memory and homeopathy [K40] and to the evolution of immune system as well.

2. The field of free energy (presumably possessing somewhat similar academic status as the research of remote mental interactions) represents second source of experimental input. Quite lately I have been reconsidering what is believed to be known about the splitting of water - for instance using strong electric fields or cavitation. This is a rich store of anomalies. In particular although the splitting of water molecules requires energy, more energy is claimed to emerge from the process in some situations. Also cold fusion is reported to occur in this kind of system and liberates energy as heat. Nuclear transmutations in living matter have been reported much before the cold fusion was claimed for the first time [C1, C3].

Already more than century ago it was reported that the resulting vapor - christened as Brown's gas according to its discoverer - behaved strangely. For instance, its temperature was 130 C but it melted metal as if it had stored a lot of energy which was liberated and was heating the metal about thousand of degrees of Celsius. These results do not of course fit standard physics and have been actively forgotten and denied by the academic environment (for an authoritative skeptic explanation see Wikipedia article <http://tinyurl.com/y7a8swzg>). I know personally some people in the field of free energy and I am not able to see them as "fringe scientists" as opposed to "real scientists". It is a pity that this kind of schizophrenic splitting prevents the study of the free energy claims using the resources provided by the academic environment.

Free energy enthusiasts have been studying this process and a lot is believed to be known about it. According to Moray B. King [H4, H2] Brown's gas can be separated from water vapor and hydrogen and is weightier than air. It is believed that charged plasma clusters resulting in the "electric expansion" of water are involved with electrons and protons separated. Torus shaped plasmoids are introduced also. In TGD framework plasmoids, which involve magnetic body carrying electron Cooper pairs at least, are identified as primordial life forms.

3. The question is how many properties assigned with chemical life are shared by plasmoids. Could linear biomolecules, storage and liberation of metabolic energy, and even genetic code have plasmoidal analogs?
  - (a) Circular sequences of OH: s has been proposed by King [H4] as basic building bricks of plasmoids. To my best understanding this does not fit with the ordinary chemistry (covalent bond between OHs cannot be realized). TGD inspired proposal consistent with King's proposal is that actually  $OHH_{dark}$  sequences are in question.

Covalent bonds are replaced with color bonds between dark nuclei, which are scaled up variants of ordinary nuclear modelled as highly entangled nucleon strings in TGD framework. Already this represents a new view about nuclear physics (it is ironic that string like appear at practically all levels in TGD Universe but that string theorists desperately try to understand physics by putting them to Planck scale).

As a matter fact, learning about the work of Gerald Pollack *et al* [L17] led to a simpler model in which dark proton sequences at magnetic flux tubes replace  $OHH_{dark}$  sequences. Predictions are almost the same except for charge separation having neat explanation in the simpler model which is actually the original model for water as partially dark phase of matter.

- (b) Free energy phenomena involve the splitting of water. Water splitting is also the first step in the storage of energy to biomolecules in photosynthesis. Could  $OHH_{dark}$  or dark proton sequences define simplified counterparts of basic biomolecules, and could they carry metabolic energy in colour bonds between dark protons replacing “high energy covalent bonds” ?
- (c) This metabolic energy would be liberated as metal melts in the presence of Brown’s gas. This is completely analogous to the splitting of biopolymers in catabolism leading to liberation of metabolic energy. This liberation does not take place in the interaction with living matter: why the conductor property of metals leads to the burning? Why the presence of conduction electrons induced the phase transition reducing  $h_{eff}$  and scaling up p-adic prime  $p$  correspondingly so that energy is liberated. Do conduction electrons perhaps serve as a seed like in ordinary phase transitions forcing the dark Cooper pairs to decay to ordinary electrons?
- (d) This framework inspires the conjecture that chemical life has preceded by plasmoids consisting of these ultra-simplified versions of basic biomolecules. “Ontogeny recapitulates phylogeny” forces to as whether this primordial life form could be still in key role living matter meaning that the role of water would be much more than serving as a passive solvent of biomolecules. The phase of water known as ordered water and having ice as the closest analog is believed to be crucial for the stability of DNA against hydrolysis, and one can wonder whether the dark DNA defined by half dark water molecule sequences could be the basic building brick of the ordered water and accompany the ordinary DNA. This would make also highly probable the analogs of transcription and translation between ordinary and dark variants of basic biopolymers. Note that Brown’s gas would be ideal fuel since it would “burn” to water: no  $CO_2$  would be produced as in case of biofuels. Again the problem is that academic community how refuses to take free energy people seriously enough to try to demonstrate that they are wrong. Free energy enthusiasts in turn seem to concentrate too much to their dream and fail to realize that Brown’s gas could carry the usable energy and the amount of this energy liberated as heat need not measure the actual success of the experiment.

### 7.3.5 Pollack’s Findings About Fourth Phase Of Water

What is described above was the view about Brown’s gas before I received a link to a Youtube lecture by Gerald Pollack about fourth gel like phase of water (see <http://tinyurl.com/oyhstc2>) [L17]. Listening this lecture provided considerable support for this picture and led to a much more detailed and also simplified view.

The discovery of negatively charged exclusion zone formed in water bounded by gel phase was the motivation for Pollack to propose the notion of gel like fourth phase of water. Below I discuss this notion from TGD point of view.

The proposal will be that the fourth phase corresponds to negatively charged regions - exclusion zones - with size up to 100-200 microns generated when energy is fed into the water - say as radiation, in particular solar radiation. The stoichiometry of the exclusion zone is  $H_{1.5}O$  and can be understood if every fourth proton is dark proton residing at the flux tubes of the magnetic body assignable to the exclusion zone and outside it. This leads to a model for prebiotic cell as exclusion zone. Dark protons are proposed to form dark nuclei whose states can be grouped to groups corresponding to DNA, RNA, amino-acids, and tRNA and for which vertebrate genetic

code is realized in a natural manner [K40, K56]. The voltage associated with the system defines the analog of membrane potential, and serves as a source of metabolic energy as in the case of ordinary metabolism. The energy is liberated in a reverse phase transition in which dark protons transform to ordinary ones. Dark proton strings serve as analogs of basic biopolymers, and one can imagine analog of bio-catalysis with enzymes replaced with their dark analogs. The recent discovery that metabolic cycles emerge spontaneously in absence of cell support this view.

### The findings

One can find a biographical sketch [I3] (<http://tinyurl.com/ycqtuchp>) giving a list of publications containing items related to the notions of exclusion zone and fourth phase of water discussed in the talk. I list below some basic experimental findings about fourth gel like phase of water made in the laboratory led by Gerald Pollack [L17].

1. In water bounded by a gel a layer of thickness up to 100-200 microns is formed. All impurities in this layer are taken outside the layer. This motivates the term “exclusion zone”. The layer consists of layers of molecular thickness and in these layers the stoichiometry is  $H_{1.5}O$ . The layer is negatively charged. The outside region carries compensating positive charge. This kind of blobs are formed in living matter. Also in the splitting of water producing Brown’s gas negatively charged regions are reported to emerge [H4, H2].
2. The process requires energy and irradiation by visible light or thermal radiation generates the layer. Even the radiation on skin can induce the phase transition. For instance, the blood flow in narrow surface veins requires metabolic energy and irradiation forces the blood to flow.
3. The layer can serve as a battery: Pollack talks about a form of free energy deriving basically from solar radiation. The particles in the layer are taken to the outside region, and this makes possible disinfection and separation of salt from sea water. One can even understand how clouds are formed and mysteries related to the surface tension of water as being due the presence of the layer formed by  $H_{1.5}O$ .
4. In the splitting of water producing Brown’s gas [H4, H2] having a natural identification as Pollack’s fourth phase of water the needed energy can come from several alternative sources: cavitation, electric field, etc...

### Dark nuclei and Pollack’s findings

While listening the lecture of Pollack I realized that a model for dark water in term of dark proton sequences is enough to explain the properties of the exotic water according to experiments done in the laboratory of Pollack. There is no need to assume sequences of half-dark water molecules containing one dark proton each.

1. The dark proton sequences with dark proton having size of order atomic nucleus would reside at the flux tubes of dark magnetic field which is dipole like field in the first approximation and defines the magnetic body of the negatively charged water blob. This explains the charge separation if the flux tubes have length considerably longer than the size scale of the blob which is given by size of small cell. In the model inspired by Moray B. King’s lectures charge separation is poorly understood.
2. An interesting question is whether the magnetic body is created by the electronic currents or whether it consists of flux tubes carrying monopole flux: in the latter case no currents would be needed. This is obviously purely TGD based possibility and due to the topology of  $CP_2$ .
3. This means that in the model inspired by the lectures of Moray B. King discussed above, one just replaces the sequences of partially dark water molecules with sequences of dark protons at the magnetic body of the  $H_{1.5}O$  blob. The model for the proto-variants of photosynthesis and metabolism remain as such. Also now genetic code would be realized.

These primitive forms of photosynthesis and metabolism form could be key parts of their higher level chemical variants. Photosynthesis by irradiation would induce a phase transition



generating dark magnetic flux tubes (or transforming ordinary flux tubes to dark ones) and the dark proton sequences at them. Metabolism would mean burning of the resulting blobs of dark water to ordinary water leading to the loss of charge separation. This process would be analogous to the catabolism of organic polymers liberating energy. Also organic polymers in living matter carry their metabolic energy as dark proton sequences: the layer could also prevent their hydration. That these molecules are typically negatively charged would conform with the idea that dark protons at magnetic flux tubes carry the metabolic energy.

The liberation of energy would involve increase of the p-adic prime characterizing the flux tubes and reduction of Planck constant so that the thickness of the flux tubes remains the same but the intensity of the magnetic field is reduced. The cyclotron energy of dark protons is liberated in coherent fashion and in good approximation the frequencies of the radiation corresponds to multiples of cyclotron frequency: this prediction is consistent with that in the original model for the findings of Blackman and others [J27].

The phase transition generating dark magnetic flux tubes containing dark proton sequences would be the fundamental step transforming inanimate matter to living matter and the fundamental purpose of metabolism would be to make this possible.

### Minimal metabolic energy consumption and the value of membrane potential

This picture raises a question relating to the possible problems with physiological temperature.

1. The Josephson radiation generated by cell membrane has photon energies coming as multiples of  $ZeV$ , where  $V$  is membrane potential about .06 V and  $Z = 2$  is the charge of electron Cooper pair. This gives  $E = .12$  eV.
2. There is a danger that thermal radiation masks Josephson radiation. The energy for photons at the maximum of the energy density of blackbody radiation as function of frequency is given as the maximum of function  $x^3/(e^x - 1)$ ,  $x = E/T$  given by  $e^{-x} + x/3 - 1 = 0$ . The maximum is given approximately by  $x = 3$  and thus  $E_{max} \simeq 3T$  (in units  $c = 1, k_B = 1$ ). At physiological temperature  $T = 310$  K (37 C) this gives .1 eV, which is slightly below Josephson energy: living matter seems to have minimized the value of Josephson energy - presumably to minimize metabolic costs. Note however that for the thermal energy density as function of *wavelength* the maximum is at  $E \simeq 5T$  corresponding to 1.55 eV which is larger than Josephson energy. The situation is clearly critical.
3. One can ask whether also a local reduction of temperature around cell membrane in the fourth phase of water is needed.

“Electric expansion” of water giving rise to charge separation and presumably creating fourth phase of water is reported to occur [H4, H2].

- (b) Could the electric expansion/phase transition to dark phase be adiabatic involving therefore no heat transfer between the expanding water and environment? If so, it would transform some thermal energy of expanding water to work and reduce its temperature. The formula for the adiabatic expansion of ideal gas with  $f$  degrees of freedom for particle ( $f = 3$  if there are no other than translational degrees of freedom) is  $(T/T_0) = (V/V_0)^{-\gamma}$ ,  $\gamma = (f + 2)/f$ . This gives some idea about how large reduction of temperature might be involved. If p-adic scaling for water volume by a power of two takes place, the reduction of temperature can be quite large and it does not look realistic.
- (c) The electric expansion of water need not however involve the increase of Planck constant for water volume. Only the Planck constant for flux tubes must increase and would allow the formation of dark proton sequences and the generation of cyclotron Bose-Einstein condensates or their dark analog in which fermions (electrons in particular) effectively behave as bosons (the anti-symmetrization of wave function would occur in dark degrees of freedom corresponding to multi-sheeted covering formed in the process).

#### Fourth phase of water and pre-biotic life in TGD Universe

If the fourth phase of water defines pre-biotic life form then the phase transition generating fourth phase of water and its reversal are expected to be fundamental elements of the ordinary metabolism, which would have developed from the pre-biotic metabolism. The following argument conforms with this expectation.

1. Cell interiors, in particular the interior of the inner mitochondrial membrane are negatively charged as the regions formed in Pollack's experiments. Furthermore, the citric acid cycle, (<http://tinyurl.com/y8ubjgnc>), which forms the basic element of both photosynthesis (<http://tinyurl.com/yauwzkho>) and cellular respiration (<http://tinyurl.com/ybeefxmb>), involves electron transport chain (<http://tinyurl.com/yat3m4vk>) in which electron loses gradually its energy via production of NADP and proton at given step. Protons are pumped to the other side of the membrane and generates proton gradient serving as metabolic energy storage just like battery. The interpretation for the electron transport chain in terms of Pollack's experiment would be in terms of generation of dark protons at the other side of the membrane.
2. When ATP is generated from ADP three protons per ATP flow back along the channel formed by the ATP synthase molecule (<http://tinyurl.com/yd5ndcyk>) (perhaps Josephson junction) and rotate the shaft of a "motor" acting as a catalyst generating three ATP molecules per turn by phosphorylating ADP. The TGD based interpretation is that dark protons are transformed back to ordinary ones and possible negentropic entanglement is lost.
3. ATP is generated also in glycolysis (<http://tinyurl.com/ybzgdgve>), which is ten-step process occurring in cytosol so that membrane like structure need not be involved. Glycolysis involves also generation of two NADH molecules and protons. An open question (to me) is whether the protons are transferred through an endoplasmic reticulum or from a region of ordered water (fourth phase of water) to its exterior so that it would contribute to potential gradient and could go to magnetic flux tubes as dark proton. This would be natural since glycolysis is realized for nearly all organisms and electron transport chain is preceded by glycolysis and uses as input the output of glycolysis (two pyruvate molecules (<http://tinyurl.com/y8v7aq9s>)).
4. Biopolymers - including DNA and ATP - are typically negatively charged. They could thus be surrounded by fourth phase of water and neutralizing protons would reside at the magnetic bodies. This kind of picture would conform with the idea that the fourth phase (as also magnetic body) is fractal like. In phosphorylation the metabolic energy stored to a potential difference is transferred to shorter length scales (from cell membrane scale to molecular scale).

In glycolysis (<http://tinyurl.com/ybzgdgve>) the net reaction  $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2(g) + 6H_2O(l) + \text{heat}$  takes place. The Gibbs free energy change is  $\Delta G = -2880$  kJ per mole of  $C_6H_{12}O_6$  and is negative so that the process takes place spontaneously. Single glucose molecule is theoretized to produce  $N = 38$  ATP molecules in optimal situation but there are various energy losses involved and the actual value is estimated to be 29-30. From  $Joule = 6.84 \times 10^{18}$  eV and  $mol = 6.02 \times 10^{23}$  and for  $N = 38$  one would obtain the energy yield.86 eV per single ATP. The nominal value that I have used.5 eV. This is roughly 5 to 8 times higher than  $E = ZeV, Z = 2$ , which varies in the range.1-16 eV so that the metabolic energy gain cannot be solely due to the electrostatic energy which would actually give only a small contribution.

In the thermodynamical approach to metabolism the additional contribution would be due to the difference of the chemical potential  $\mu$  for cell exterior and interior, which is added to the membrane potential as effective potential energy. The discrepancy is however rather large and this forces the question the feasibility of the model. This forces to reconsider the model of osmosis in the light of Pollack's findings.

#### Pollack's findings in relation to osmosis and model for cell membrane and EEG

Osmosis (<http://tinyurl.com/yc5dbtzv>) has remained to me poorly understood phenomenon. Osmosis means that solvent molecules move through a semipermeable membrane to another side

of the membrane if the concentration of solute is higher at that side. Solute can be water or more general liquid, supercritical liquid, and even gas.

Osmosis is not diffusion: it can occur also towards a higher concentration of water. Water molecules are not attracted by solute molecules. A force is required and the Wikipedia explanation is that solute molecules approaching pores from outside experience repulsion and gain momentum which is transferred to the water molecules.

The findings of Pollack inspire the question whether the formation of exclusion zone could relate to osmosis and be understood in terms of the fourth phase of water using genuine quantal description.

In the thermodynamical model for ionic concentrations one adds to the membrane resting potential a contribution from the difference of chemical potentials  $\mu_i$  at the two sides of the membrane. Chemical potentials for the ions parametrize the properties of the cell membrane reducing basically to the properties of the channels and pumps (free diffusion and membrane potential do not entirely determine the outcome).

If the transfer of ions - now protons - through cell membrane is quantal process and through Josephson junctions defined by transmembrane proteins, then the thermodynamical model can at best be a phenomenological parameterization of the situation. One should find the quantum counterpart of thermodynamical description, and here the identification of quantum TGD as square root of thermodynamics in Zero Energy Ontology (ZEO) suggests itself. In this approach thermodynamical distributions are replaced by probability amplitudes at single particle level such that their moduli squared give Boltzmann weights.

1. *Simplest Josephson junction model for cell membrane*

The first guess is that quantum description is achieved by a generalization of the Josephson junction model allowing different values of Planck constant at magnetic flux tubes carrying dark matter.

1. Josephson junctions correspond microscopically to transmembrane proteins defining channels and pumps. In rougher description entire cell membrane is described as Josephson junction.
2. The magnetic field strength at flux tube can differ at the opposite side of the membrane and even the values of  $h_{eff}$  could in principle be different. The earlier modelling attempts suggest that  $h_{eff}/h = n = 2^k A$ , where  $A$  is the atomic weight of ion, is a starting assumption deserving testing. This would mean that each ion resides at its own flux tubes.

The phase transitions changing the value of  $h_{eff}$  could induce ionic flows through cell membrane, say that occurring during nerve pulse since the energy difference defining the ratio of square roots of Boltzmann weights at the two sides of the membrane would change. Also the change of the local value of the magnetic field could do the same.

Consider first the simplest model taking into account only membrane potential.

1. The simplest model for Josephson junction defined by the transmembrane protein is as a two state system  $(\Psi_1, \Psi_2)$  obeying Schrödinger equation.

$$i\hbar_1 \frac{\partial \Psi_1}{\partial t} = ZeV\Psi_1 + k_1\Psi_2 \quad ,$$

$$i\hbar_2 \frac{\partial \Psi_2}{\partial t} = k_2\Psi_1 \quad .$$

One can use the decomposition  $\Psi_i = R_i \exp(i\Phi(t))$  to express the equations in a more concrete form. The basic condition is that the total probability defined as sum of moduli squared equals to one:  $R_1^2 + R_2^2 = 1$ . This is guaranteed if the hermiticity condition  $k_1/\hbar_1 = \overline{k_2}/\hbar_2$  holds true. Equations reduce to those for an ordinary Josephson junction except that the frequency for the oscillating Josephson current is scaled down by  $1/h_{eff}$ .

2. One can solve for  $R_2$  assuming  $\Phi_1 = eVt/\hbar_{eff}$ . This gives

$$R_2(t) = \sin(\Phi_0) + \frac{k_1}{\hbar_1} \sin\left(\frac{eVt}{\hbar_1}\right) \quad .$$

$R_2$  oscillates around  $\sin(\Phi_0)$  and the concentration difference is coded by  $\Phi_0$  taking the role of chemical potential as a phenomenological parameter.

3. The counterparts of Boltzmann weights would be apart from a phase factor square roots of ordinary Boltzmann weights defined by the exponent of Coulomb energy:

$$R = \sin(\phi_0) = \exp\left(\frac{ZeV(t)}{2T}\right) .$$

Temperature would appear as a parameter in single particle wave function and the interpretation would be that thermodynamical distribution is replaced by its square root in quantum theory. In ZEO density matrix is replaced by its hermitian square root multiplied by density matrix.

### 2. The counterpart of chemical potential in TGD description

This model is not as such physically realistic since the counterpart of chemical potential is lacking. The most straightforward generalization of the thermodynamical model is obtained by the addition of an ion dependent chemical potential term to the membrane potential:  $ZeV \rightarrow ZeV + \mu_I$ . This would however require a concrete physical interpretation.

1. The most obvious possibility is that also the chemical potential actually correspond to an interaction energy - most naturally the cyclotron energy  $E_c = \hbar_{eff} ZeB_{end}/m$  of ion - in this case proton - at the magnetic flux tube. Cyclotron energy is proportional to  $\hbar_{eff}$  and can be rather large as assumed in the model for the effects of ELF em fields on brain.
2. This model would predict the dependence of the effective chemical potential on the mass and charge of ion for a fixed value of on  $\hbar_{eff}$  and  $B_{end}$ . The scales of ionic chemical potential and ion concentrations would also depend on value of  $\hbar_{eff}$ .
3. The model would provide a different interpretation for the energy scale of bio-photons, which is in visible range rather than infrared as suggested by the value of membrane potential.

The earlier proposal [K37] was that cell membrane can be in near vacuum extremal configuration in which classical  $Z^0$  field contributes to the membrane potential and gives a large contribution for ions. The problematic aspect of the model was the necessity to assume Weinberg angle in this phase to have much smaller value than usually. Furthermore, for proton the  $Z^0$  contribution is negligible in good approximation so that this model does not explain the high value of the metabolic energy currency.

4. The simplest model the communications to magnetic body rely on Josephson radiation whose fundamental frequency  $f_J$  is at resonance identical with the cyclotron frequency  $f_c(MB)$  at particular part of the flux tube of the magnetic body:  $(f_c(MB) = f_J)$ .  $f_c(MB)$  corresponds to EEG frequency in the case of brain and biophotons are produced from dark EEG photons as ordinary photons in phase transition reducing  $\hbar_{eff} = n \times h$  to  $h$ .

In the modified model the sum  $f_c + f_{J,n}$  ( $f_{J,n} = E_J/n \times h$ ) of  $\hbar_{eff}$ -independent cyclotron frequency and Josephson frequency proportional to  $1/\hbar_{eff}$  equals to cyclotron frequency  $f_c(MB)$  at "personal" magnetic body varying slowly along the flux tube:  $f_c + f_{J,n} = f_c(MB)$ . If also the variation of  $f_J$  assignable to the action potential is included, the total variation of membrane potential gives rise to a frequency band with width roughly

$$\frac{\Delta f}{f} \simeq \frac{2f_{J,n}}{f_c + f_{J,n}} = \frac{2f_{J,1}}{nf_c + f_{J,1}} .$$

If dark photons correspond to biophotons the energy of cyclotron photon is in visible and UV range one has  $nf_c = E_{bio}$  and

$$\frac{\Delta f}{f} \simeq \frac{2ZeV}{E_{bio} + ZeV} .$$

The prediction is scale invariant and same for all ions and also electron unless  $E_{bio}$  depends on ion. For  $eV = .05$  eV,  $Z = 1$ , and  $E_{bio} = 2$  eV ( $f \simeq 5 \times 10^{14}$  Hz) one has  $\Delta f/f \sim .1$  giving 10 per cent width for EEG bands assumed in the simpler model.

If this vision is on the correct track, the fundamental description of osmosis would be in terms of a phase transition to the fourth phase of water involving generation of dark matter transferred to the magnetic flux tubes. For instance, the swelling of cell by an in-flow of water in presence of higher concentration inside cell could be interpreted as a phase transition extending exclusion zone as a process accompanied by a phase transition increasing the value of  $h_{eff}$  so that the lengths of the flux tube portions inside the cell increase and the size of the exclusion zone increases. In general case the phase transitions changing  $h_{eff}$  and  $B_{end}$  by power of two factor are possible. This description should bring magnetic body as part of bio-chemistry and allow understanding of both equilibrium distributions, generation of nerve pulse, and basic metabolic processes leading to the generation of ATP.

### Why would charge separation generate large $h_{eff}$ ?

The basic question is whether and how the separation of electron and proton charges generates large  $h_{eff}$ ? A possible mechanism emerged from a model [K91] explaining anomalously large gravimagnetic effect claimed by Tajmar *et al* [E6, E11] to explain the well-established anomaly related to the mass of Cooper pairs in rotating super-conduction. The mass is too large by fraction of order  $10^{-4}$  and the proposal is that gravimagnetism changes slightly the effective Thomson magnetic field associated with the rotating super-conductor leading to wrong value of Cooper pairs mass when only ordinary Thomson field is assumed to be present. The needed gravimagnetic field is however gigantic: 28 orders larger than that predicted by GRT. Gravimagnetic field is proportional  $h_{eff}^2$  in TGD and if one uses  $h_{gr}$  for electron-Earth system one obtains correct order of magnitude.

Nottale's finding that planetary orbits seem to correspond to Bohr orbits in gravitational potential with gigantic value of gravitational Planck constant is the basic input leading to the model of gravimagnetic anomaly.

1. By Equivalence Principle  $h_{gr}$  has the general form  $h_{gr} = GMm/v_0$ , where  $M$  and  $m$  are the interacting masses and  $v_0$  is a parameter with dimensions of velocity. For 4 inner planets one has  $v_0/c \simeq 2^{-11}$ .
2. The notion of  $h_{gr}$  generalizes to that for other interactions. For instance, in electromagnetic case the formation of strong em fields implying charge separation leads to systems in which  $h_{em} = Z_1 Z_2 e^2 / v_0$  is large. Pollack's exclusion zone and its complement define this kind of systems and is identified as prebiotic life form.
3. Since the natural expansion parameter of perturbative expansion is the  $g^2/4\pi\hbar$ , one can say that transition to dark matter phase make the situation perturbative. Mother Nature is theoretician friendly.

$h_{em}$  might be large in the exclusion zones (EZ) appearing in the water bounded by gel and their variants could play central role in living matter.

1. EZ carries very large negative charge with positive charge outside the exclusion zone.
2. TGD interpretation is in terms of  $H_{1.5}O$  phase of water formed when every 4: th proton is transferred to magnetic body as dark particle with large value of  $h_{eff}$ . The proposal is that primitive life form is in question.
3. The pair formed by EZ and its complement could have large value of  $h_{eff} = h_{em} = Z^2 e^2 / v_0$ .
4. The velocity parameter  $v_0$  should correspond to some natural rotation velocity. What comes in mind is that complement refers to Earth and  $v_0$  is the rotation velocity at the surface of Earth. The prediction for  $h_{eff}$  would be of order  $h_{em}/h = 4\pi\alpha Z^2 \times .645 \times 10^6 \simeq 5.9 \times 10^4 Z^2$ .
5. Cell membrane involves also large charge separation due to very strong electric field over the cell membrane. Also now dark phases with large  $h_{em}$  or  $h_{gr}$  could be formed.

I have proposed that metabolic machinery generates large  $h_{eff}$  phase somehow.  $h_{eff} = h_{em}$  hypothesis allows to develop this hypothesis in more detail.

1. I have speculated earlier [K44] that the rotating shaft of a molecular motor associated with ATP synthase plays a key role in generating dark matter phase. What comes in mind is that charge separation takes place associating exclusion zone with the shaft and the rotational velocity  $v_0$  of the shaft appears in the formula for  $h_{em}$ . Of course, some numerical constant not far from unity could be present. The electric field over the mitochondrial membrane generates charge separation. One can imagine several identifications for the product of charges. The charge  $Z$  associated with the complement would be naturally associated with single dark flux tube containing dark nucleon consisting of dark protons. For instance, the charge associated with the exclusion zone could be the charge of the electronic Cooper pair giving  $h_{em} = 2e \times Z/v_0$ .
2. The value of  $v_0/c$  is expected to be of order  $10^{-14}$  from the angular rotation rate of ADP synthase about few hundred revolutions per second. The order of magnitude for  $h_{em}$  could be same as for  $h_{gr}$  associated with Earth-particle system.

$h_{eff}(ATP\text{synthase}) = h_{gr}(2e, Earth)$  would make possible reconnection of electromagnetic flux tubes with gravimagnetic flux tubes [K72].

### Is time reversal involved with Pollack effect?

EZs have the very strange property that the impurities are spontaneously removed from them. This seems to be in conflict with the second law of thermodynamics according to which both temperature and concentration gradients should tend to disappear. Could one understand this as being due to a reversal of the arrow of time?

Indeed, TGD inspired theory of consciousness relying on zero energy ontology (ZEO) predicts the possibility of time reversed selves [L40]. When conscious entity - self - dies, it reincarnates as a self with opposite arrow of geometric time.

1. In ZEO zero energy states replace ordinary quantum states assigned with time=constant snapshots of time evolution in space-time. Zero energy states are pairs of ordinary quantum states at opposite light-like boundaries of causal diamond (CD) identifiable as counterparts of initial and final states of a physical event. Conservation quantum numbers translates to a mathematical statement that the quantum numbers associated with the members of pairs are opposite. One can also say that zero energy state is analogous to a deterministic computer program or a behavioral mode. The act of free will replaces this program/behavior with a new one so that one avoids the paradox between the non-determinism of free will and determinism of physics.
2. Causal diamond (CD) defines the embedding space correlate of self. One can assign to the opposite light-like boundaries the attributes active and passive. During the sequence of analogs of "small" state function reductions analogous to weak quantum measurements (resembling classical measurements) the passive boundary remains unaffected as also the members of state pairs defining zero energy states associated with it. Active boundary recedes farther away from the passive boundary and the members of state pairs at it change. The size of CD thus increases and gives rise flow of geometric time as an increase of the temporal distance between the tips of CD.
3. Eventually the first state function reduction to the opposite boundary of CD must occur, and active and passive boundary change their roles. Self dies and re-incarnates as a self with opposite arrow of geometric time: the formerly passive boundary of CD becomes now active and moves in opposite time direction reduction by reduction. In the next re-incarnation self continues almost from the moment of geometric time at which it died. It might be that we die repeatedly without noticing it at all!
4. The many-sheeted space-time approximated with slightly curved regions of Minkowski space would certainly tend to mask the time reversals in given length scale. In elementary particle

length scales the state function reductions would indeed change the arrow of time but this would occur so often that there would be no arrow of time in statistical sense: one would speak of microscopic reversibility. In time scales considerably longer than those of human consciousness the observed arrow of time would correspond to that associated with selves with very large CDs and with lifetime much longer than ours. The change of the arrow of time could be detectable in time scales relevant to living matter and human consciousness and just these scales are the scales where the anomalies occur!

Could the ghostly space-time regions - time reversed selves - have some physical signatures making possible to prove their existence empirically?

1. Second law would still hold true but in opposite direction of geometric time for the space-time sheets with non-standard arrow of time. The effects implied by second law would be present as their reversals. The observer with standard direction of geometric time would see temperature and density gradients to develop spontaneously. Also parameters describing dissipation rates such as Ohmic resistance and viscosity could have in some situations negative values.

This indeed seems to take place in living matter. For instance, the building bricks of molecules spontaneously arrange to molecules: DNA replication, transcription and translation of RNA to proteins are basic examples about this. The development of concentration gradients is also clear in the strange ability of EZs to get rid of impurities. Also the charge separation creating EZs could be seen as disappearance of charged separation in reversed direction of time. Healing of living organism could be a basic example of the process in which the arrow of time changes temporarily at some level of hierarchy of space-time sheets.

2. The generation of temperature gradients would be a clear signature for the reversal of the arrow of time. Water is the basic stuff of life, and the thermodynamics of water involves numerous anomalies summarized at Martin Chaplin's homepage "Water structure and science" (see <http://tinyurl.com/ye77f7d>). TGD based explanation could be naturally in terms of dark variants of protons at magnetic flux tubes and possible change of the arrow of geometric time.
3. There is a lot of anecdotal evidence for the effects challenging our beliefs about standard arrow of time. A spontaneous generation of temperature differences is basic example. There is a nice popular document about this boundary region of science by Phie Ambo (see <http://tinyurl.com/yaog8h39>), which even skeptic might enjoy as art experience.

It was a great surprise for me that one of the key personalities in the document is Holger B Nielsen, one of the pioneers of string models. I have had the honor to have intense discussions with him in past: he is one of the very few colleagues who has shown keen interest on the basic ideas of TGD. The document discusses strange phenomena associated with the physics of water possibly having interpretation in terms of time reversal and formation of EZs. From the document one also learns that in Denmark physics professionals are beginning to take these anomalies seriously.

Unfortunately, the people who claim having discovered this kind of effects - often not science professionals - are labelled as crackpots. The laws of science also tell what we are allowed to observe (and think), at least if we want to be called scientists!

4. The ghost stories might also reflect something real - this real need of course not be ghost but something deep about consciousness. Could it be that it is sometimes possible to consciously experience the presence of a space-time region - self - with an opposite arrow of geometric time? Ghost stories typically involve a claim about the reduction of temperature of environment in presence of ghost: could this be something real and a signature for the reversal of time at some level of dark matter hierarchy affecting also dark matter? As a matter of fact, in TGD Universe our conscious experience could involve routinely sub-selves (mental images) with non-standard arrow of time [L40]: motor actions could be identified as sensory mental images with opposite arrow of time.

### Which came first: metabolism or cell membrane?

One of the basic questions of biology is whether metabolism preceded basic biopolymers or vice versa. RNA world scenario assumes that RNA and perhaps also genetic code was first.

1. The above view suggests that both approaches are correct to some degree in TGD Universe. Both metabolism and genetic code realized in terms of dark proton sequences would have emerged simultaneously and bio-chemistry self-organized around them. Dark proton sequences defining analogs of amino-acid sequences could have defined analogs of protein catalysts and played a key role in the evolution of the metabolic pathways from the primitive pathways involving only the phase transition between ordinary water and fourth phase of water.
2. There is very interesting article (see <http://tinyurl.com/ycdhd4fd>) [I4] reporting that complex metabolic pathways are generated spontaneously in laboratory environments mimicking hot thermal vents. Glycolysis and pentose phosphate pathway were detected. The proposal is that these pathways are catalyzed by metals rather than protein catalysts.
3. In standard biology these findings would mean that these metabolic pathways emerged before basic biopolymers and that genetic code is not needed to code for the metabolic pathways during this period. In TGD framework dark genetic code [K40, K56] would be there, and could code for the dark pathways. Dark proton strings in one-one correspondence with the amino-acid sequences could be responsible for catalysts appearing in the pathways. Only later these catalysts would have transformed to their chemical counterparts and might be accompanied by their dark templates. One cannot even exclude the possibility that the chemical realization of the DNA-amino-acid correspondence involves its dark analog in an essential manner.

## 7.4 TGD View About Metabolism

The general strategy in TGD based attempts to understand metabolism [K44] is based on the assumption that a very large class of anomalous phenomena rely on same basic mechanism. This includes life as a gigantic collection of anomalies, water memory and homeopathy, free energy phenomena involving over-unity energy production related to the dissociation of water, lightning and ball lightning, anomalous effects associated with rotating magnetic systems, phenomena related to UFOs (light balls), and remote mental interactions. One must have a unified explanation for all these phenomena based on a real theory.

Plasmoid as primitive life form would be the underlying connecting thread between these phenomena so that all the listed phenomena would involve life and prebiotic (or/and possibly post-biotic!) life. This gives very strong constraints on the model. Plasmoid should consist of the analogs of linear biomolecules, it should metabolize and communicate, in TGD Universe it should have magnetic body, and even genetic code might be realized. In particular, the simplified analog of biological metabolism would be at work. In living matter photosynthesis relies on the splitting of water whereas cell respiration relies on the reversal of this process producing carbon di-oxide and water. Something very similar should happen in free energy systems involving electrolysis, and the fact that water splitting occurs also in several free energy phenomena suggests that these processes are analogous to photosynthesis and store energy to “molecules” analogous to various linear biomolecules, in particular sugars. Even the simplified version of ADP-ATP process might be realized.

TGD suggests a very general model for the metabolism of pre-biotic systems identified as plasmoids consisting of cyclic linear structures formed by exotic water molecules. For a dark water molecule one proton would be dark and dark protons of the neighboring exotic water molecules would bind to form a linear structure identifiable as dark nucleus: this picture is a direct generalization of nuclear string model [K33, K30, K56]. These linear structures would define the analogs of linear biomolecules. This metabolism would be more fundamental than ordinary biochemical metabolism and form a yet unknown part of the latter. One cannot exclude the possibility that



also other than water molecules contain dark protons: the signature would be the presence of apparently non-allowed covalent bonds due to the fact the dark proton is not visible. In the following I will discuss the basic principles involved.

The older view about the metabolic energy quanta as energies liberated as particle “drops” to a larger space-time sheet is modified (an objection against this mechanism is that its coherence for many particles is far from obvious). Metabolic energy quanta are liberated when the space-time sheet at which the particles reside expands in a phase transition increasing its p-adic prime and reducing the value of Planck constant correspondingly so that the net result is that the size of the space-time sheet remains the same. This condition implies a close relationship between p-adic and dark matter hierarchies. This process is automatically coherent since all particles suffer the change simultaneously. It applies also to a situation in which particles are in magnetic field: in this case the scale of cyclotron energies changes since the strength of the magnetic field is scaled down to guarantee the conservation of magnetic flux. This transition is not cyclotron transition but liberates essentially the same energy as coherent cyclotron transition so that magnetic fields (their “motor actions” ) become essential players also in metabolic activities.

### 7.4.1 Three Possible Models For Liberation Of Metabolic Energy

One can imagine three different models for the liberation of metabolic energy.

1. The simplest TGD based model is as a phase transition increasing the value of p-adic prime  $p$  assignable to the space-time sheet at which particle is topologically condensed:
  - (a) Particle drops to a larger space-time sheet with larger p-adic prime  $p_1$  with  $p_1/p \simeq 2^k$ . The problem is that different particles need not drop simultaneously so that coherent liberation of energy is not automatic consequence of the assumption.
  - (b) The space-time sheet itself suffers a phase transition increasing its p-adic length scale. In absence of interactions (particles in box) the energies are scaled down by factor  $2^{-k}$  and the difference is liberated as usable energy. Coherent liberation of energy is achieved automatically. If the particle insider the space-time sheet is free in good approximation a model as particle in box applies, and if the expansion of the space-time sheet takes place adiabatically, the quantum numbers characterizing the state of the particle do not change in the transition. As a consequence, the energy  $E_{\{n_i\}} = k \sum_i n_i^2 \hbar^2 / 2mL_p^2$  is reduced as  $L_p \propto \sqrt{p}$  increases to  $L_{p_1}$ , where  $p_1/p \simeq 2^k$  holds true. The difference of vacuum energies is liberated as usable energy in coherent manner: this is of special significance in living systems. This has led to the identification of p-adic length scales that would correspond to fundamental metabolic quantum with value about .5 eV. Entire hierarchy of metabolic quanta is predicted.
2. The space-time sheet could also carry magnetic energy and particles are expected to be in cyclotron states and perhaps form a cyclotron Bose-Einstein condensate. In this case the phase transition reduces the value of  $B$  but preserves the magnetic flux so that  $B \rightarrow B/2^k$ ,  $p_1/p \simeq 2^k$ , takes place. This scales down the energies of cyclotron states by the same scaling factor  $2^{-k}$  as in the case of free particle. The liberated energy is in good approximation just the cyclotron energy for large enough values of  $k$ . Coherence is achieved automatically. The value of the fundamental metabolic energy quantum and the value of endogenous magnetic field of about  $B_{end} = .2$  Gauss deduced from the experiments of Blackman and others [J36] fix the value of  $h_{eff}$ . It would be proportional to particle mass number  $A$ .
3. The earlier model for the liberation of cyclotron energy was based on the assumption that the value of  $B$  is not changed but that the value of magnetic quantum number  $n$  changed. If  $n$  is reduced one achieves liberation of energy. Coherence of the transition might produce problems now. Both models can explain the observations of Blackman and others concerning the effects of ELF radiation on vertebrate brain since the spectrum of photons energies inducing effects correspond to cyclotron energies for the latter option and in excellent approximation to it for the previous model. The mechanism is however quite different.

This phase transition for the larger space-time sheet can take place in two steps.

1. First a phase transition increasing  $h_{eff}$  of the background space-time sheet by  $n = 2^k$  occurs. This leaves ZPKE invariant but scales up the size of the space-time sheet by  $2^{k/2}$ . The interpretation would be as “electric expansion” of Brown’s gas. No energy transfer takes place since both kinetic and magnetic energies are invariant under the scaling of  $\hbar$ . Note however than in the original situation the magnetic field can be very strong so that zooming up from microscopic scales can happen.
2. After this a phase transition reducing Planck constant back to  $h$  but increasing p-adic length scale by  $2^k$  occurs. The size scale of the background space-time sheet is not affected but the zero point kinetic energy is reduced by factor  $2^{-k}$  and liberated as usable energy. This phase transition would take place for the dark component of Brown’s gas in the melting of the metal and other similar phenomena. Also the liberation of metabolic energy in living matter could correspond to this phase transition.

This model for electric expansion, implosion, and energy liberation assumes nothing about the particles involved since dark particle means ordinary particle topologically condensed on dark space-time sheet and having wave function de-localized in the n-sheeted structure. For instance, water can be dark in this sense. One could indeed consider the possibility that the vapor phase identified as charged water cluster is just water containing positive ions  $H_+^3$  or protons and electrons and that phase transition to large  $\hbar$  phase expands the space-time sheet at which water is topologically condensed at evaporates the water. Ordinary liquid to gas transition could proceed in the same manner and involve liberation of ZPKE at the second step of the process. In the general case the binding energy involved with the formation of the denser phase could compensate for the energy gain in the increase of the p-adic prime so that the melting would require energy feed.

### 7.4.2 Where The Metabolic Energy Is Stored?

High energy phosphate bond is one of the problematic notions of standard biology, and has served as inspiration in attempts to understand metabolism in TGD framework. The ideas have evolved gradually and the only defense for those which have survived is that they are inspired by a rather wide spectrum of anomalies including biology, neuroscience, and free energy phenomena so that the constraint of internal consistency eliminates many options.

1. The notion of negentropic entanglement allows to consider the possibility of bound states which have wrong sign of binding energy. Entanglement would be stable because it is negentropic rather than being characterized by binding energy. This led to the idea that high energy phosphate bond as a carrier of negentropic entanglement. The milder assumption is that ATP has the ability to generate it. The problem is that one can imagine endless variety of mechanisms without further conditions.
2. A highly attractive idea is that magnetic body could serve as the fundamental storage of metabolic energy with negative energy photons serving as a way to extract energy from the personal magnetic body or even other magnetic bodies. This would locate higher energy phosphate bond to magnetic flux tube and suggests that the energy is assignable to an analog of Cooper pair. This vision inspires also speculations about future energy technologies.
3. The generalization of the simple picture about liberation of metabolic energy as associated with the dropping of particle to a larger space-time sheet to a phase transition liberating cyclotron energy of charged particles led to the realization that also the phase transitions in which p-adic length scale increases by  $2^{k/2}$  factor and  $h_{eff}$  decreases by factor  $2^{-k}$  so that the size of space-time sheet remains the same, liberate kinetic energy or magnetic energy and this happens coherently and simultaneously for all particles involved. This mechanism makes essentially the same predictions about effects of ELF em fields at multiplet of cyclotron frequencies (in good approximation).

In many-sheeted space-time particles topologically condense at all space-time sheets having projection to given region of space-time so that this option makes sense only near the boundaries of space-time sheet of a given system. Also p-adic phase transition increasing the size of the space-time sheet could take place and the liberated energy would correspond to

the reduction of zero point kinetic energy. Particles could be transferred from a portion of magnetic flux tube portion to another one with different value of magnetic field and possibly also of Planck constant  $h_{eff}$  so that cyclotron energy would be liberated.

4. The negentropic states with wrong sign of binding energy could also correspond to cyclotron states with large  $h_{eff}$  (equally well to the states of a free particle in box, now space-time sheet). Magnetic body could carry metabolic energy and negentropic entanglement as that associated with dark pairs of charged particles. Because of their small mass electrons carry highest energy for given value of  $h_{eff}$  and magnetic field  $B$ . The deep irony is that one cannot automatically exclude even the elusive neutrinos as key players of metabolism: neutrinos have even smaller masses than electron and would carry even more energy in classical  $Z^0$  magnetic fields possible in cell scales for large enough values of  $h_{eff}$  [K69] !
5. Also ordinary biomolecules can be said to carry metabolic energy in covalent bonds: one could therefore assign the attribute “high energy” also the them. Do we really understand these bonds or do we just accept and forget? Do we really understand what the valence electron pairs associated with covalent bonds are? Is this really nothing but standard chemistry understood for long time ago? To my best knowledge we cannot deduce the existence of chemical bonds from Schrödinger equation because the numerics gets too intensive and choose to believe on reductionistic dogma. Hence there is some room for imagination.

- (a) Concerning covalent bond, the first option is conservative and based on the free energy inspired idea that the orderer water stabilizing DNA corresponds to dark DNA sequences. If this situation prevails also for RNA and proteins known to be surrounded by order water, one can wonder whether the covalent bonds are indeed more or less standard chemistry but that it is dark DNA parallel to the ordinary DNA that carries the metabolic energy as cyclotron energy liberated as the biopolymer and its dark variant image is catabolized. The metabolic energy would be carried by the same structures as in the case of plasmoids which would be therefore be a key element of also life as we know it!

For this option the long color flux tubes carrying quark or electron pairs would give rise to the flux tubes needed for reconnections. The transfer of metabolic energy would rely on reconnection mechanism transferring also electron Cooper pairs. Dark and thus scaled-up variant of strong interactions would become perhaps the most essential part of biophysics! Chirality selection suggests strongly that also dark variant of weak physics is in a central role in living matter.

- (b) Second option suggests a radically new view about covalent bond itself. Could valence bonds corresponds to Kähler magnetic flux loops carrying this kind of dark electron pair? Could they define the loops by which biomolecules could touch each other and reconnect to form dynamical webs. Could the fundamental energy transfer process be the transfer of electron pair between molecules involving two reconnections so that piece of magnetic loop would be exchanged? Could ATP could simply give piece of flux loop containing dark electron pair to the biomolecule as it is constructed?
6. Both options would unify also biochemistry with DNA as topological quantum computer vision. DNA sequences accompanied by magnetic flux loops would make possible DNA-cell membrane flux tube connections and topological quantum computer. Also for DNA as topological quantum computer I have considered two options: one for which quarks and antiquarks are associated with the ends of flux tubes and second one in which only electron pairs are involved [K3].

These ideas are of course speculative and time will probably show that Nature has not chosen them. What I see as the beauty of the general picture is that all relevant elements of biology at molecular level would reduce to the basic “motor actions” for magnetic body and their effects on cyclotron Bose-Einstein condensates. Same can be said about basic elements of consciousness: directed attention and sensing the presence of other molecule relying on the use of cyclotron frequencies as passwords and reconnection of flux tubes.

### 7.4.3 Dark Photon-Bio-Photon Connection

TGD inspired model for bio-photons is as ordinary photons resulting as decay products of dark photons in energy-momentum conserving decay. I have discussed this model [K18] [K10] using the input from the findings of Persinger *et al* [J40, J41, J42].

1. In the first article (see <http://tinyurl.com/y7nbr496>) [J40] entitled *Congruence of Energies for Cerebral Photon Emissions, Quantitative EEG Activities and  $\sim 5$  nT Changes in the Proximal Geomagnetic Field Support Spin-based Hypothesis of Consciousness* correlations between cerebral photons emissions, EEG, and changes of the proximal geomagnetic field are reported. The findings provide support for the proposal of Hu and Wu [J55] that nerve pulse activity could induce spin flips of spin networks assignable to cell membrane motivated by the observation that the magnetic spin-spin interaction between protons at a distance of 10 nm (cell membrane thickness) corresponds to energies for which frequency is in EEG range.
2. In the second article (see <http://tinyurl.com/ycv53lye>) [J41] entitled *Demonstration of Entanglement of "Pure" Photon Emissions at Two Locations That Share Specific Configurations of Magnetic Fields: Implications for Translocation of Consciousness* the group reports an excess correlation between "pure" photon emissions at two locations separated by few meters that share specific correlations of frequency modulated magnetic fields. The photon emissions were from LEDs in the experiment consider. In an earlier similar experiment, which is also discussed, they were from chemical reactions occurring in solutions contained by cell cultures.
3. In the third article (see <http://tinyurl.com/ya4yb6bc>) [J42] entitled *Experimental Demonstration of Potential Entanglement of Brain Activity over 300 Km for Pairs of Subjects Sharing the Same Circular Rotating, Angular Accelerating Magnetic Fields: Verification by s\_LORETA, QEEG Measurements* an excess correlation of brain activity of subject persons separated by 300 km and sharing the same circular rotating, angular accelerating magnetic fields is reported.

The frequencies of the ordinary and dark photon are predicted to be in integer ratio  $f_h/f_l = h_{eff}/h = n$  and I have already considered amplitude modulation as a way to produce dark photons and mentioned Cyril Smith's experiments which can be interpreted in terms of this transformation.

1. The bio-photon emissions at two ends should be compared. The correlations between temporal patterns would be one basic signature. Temporal correlations are extremely important and should be studied further: otherwise the findings are taken as mere claims by mainstream.
2. Collection of frequencies as a password is the rather strongly TGD based prediction. Common frequencies at both ends define second signature. Phase transitions changing frequencies but preserving photon energies are of course possible so that also sub-harmonics must be considered. More specific predictions lead soon to bio-electromagnetism. I do not know whether bio-electromagnetists have continued the work of pioneers or whether anything is done nowadays.

This picture raises an interesting question: suppose that one has identified a collection of frequencies responsible for a biological password. Could one produce these effects artificially using these frequencies to modulate a carrier wave corresponding to some bio-photon frequency?

3. Time delay is one signature and would give idea about how long distance the radiation travels and at the same time can give additional support for magnetic bodies of astrophysical size, which is certainly the most astral looking feature of TGD model for biologist.

Delayed luminescence is also a phenomenon related to bio-photons. Delayed luminescence has been produced as a model of visual after images: this could apply to all mental after images. TGD enthusiast could see after images as a indirect support for the idea that communications to and from the layers of magnetic body take place and require definite time measuring directly the size scale of the layer. The time delay is rather long in the model of after images so that the magnetic bodies in question would be rather large involving photon

travels over cosmic distances! Mainstream thinking suggests that some other mechanism is in question and the complexity of nervous system certainly allows to invent alternative mechanisms.

4. The ability to tune the cyclotron and Josephson frequencies by varying magnetic field would be basic magnetic motor skill of the meditator besides ability to move magnetic body parts to make reconnections more probable. For Josephson frequencies this skill would mean the ability to tune the value of the membrane voltage and Josephson frequency characterized by the associated value of  $h_{eff}$ . If given receptor-information molecule pair corresponds to a particular value of  $h_{eff}$  defining a connection to a particular magnetic body part as will be suggested below, an advanced meditator would have developed the ability to control the density of the receptor-information molecule pairs.
5. How to detect changes of cyclotron frequencies? In Persinger's experiments, magnetic field identified as that of Earth, was slightly reduced and therefore also the frequency. Could one learn to detect the tuning of the value of magnetic field? Can one demonstrate the ability of meditator to modify these frequencies? Can one try to identify the place where the radiation with these frequencies originates. Can one characterise body parts by slightly differing frequencies and build a kind of frequency map about body? Do deviations from standard values characterize unhealthy state?

## 7.5 Questions

The following represents answers to the 3<sup>rd</sup> JNL Panel on meditation, mind-body medicine and placebo based on the previous summary of TGD perspectives on consciousness and quantum biology. The introduction of the article should help to obtain a very short overview about the background.

### 7.5.1 I: Long Term Meditation Remodelling And Its Effects On Bio-Photon Emissions

Q1: Is the plasticity restricted to brain? Could meditation/visualization trigger BPE/redox-regulated changes in body wide microtubule arrays increasing coherence and synchronization?

A: I see no deep reason why plasticity would be restricted to brain alone. Brain might have however achieved highest level of plasticity because it represents a kind of "postmodern" layer in the evolution of cell cultures allowing cellular individualism. An interesting question in TGD framework is also the plasticity of magnetic body. Is meditation reshaping the magnetic body, making it more plastic so that it can build reconnections and in this manner direct attention more sharply and more stably?

Q4. Would the increased alpha power, brain connectivity and synchronization translate into greater amplitudes and bio-photon field coherence throughout the organism? And is there any mechanism through which BPE's could be reflected within the body's various conduction matrices (neural system, the mitochondria-microtubule reticulum – see Rahnama *et al*, 2011) acting like a resonant cavity for laser-like amplification of EEG-pumped BPEs, in order to reach the requisite thresholds for biological action?

If there is a common mechanism of action between LLLT and mind-body healing, as suggested by the parallels reviewed in the discussion above, then of particular interest is the fact that proficient qigong meditators appear capable of directing bio-photon emissions to specific areas of the body [see "Intent-directed localization" section in bibliography]. Given that LLLT is limited in the depth of effective tissue irradiation, the prospect of targeted delivery of specific frequencies is quite intriguing. On the other hand, the actual intensity of bio-photon fields inside the cells and the robustness of quantum coherence at physiological temperatures remain controversial issues (Tafur *et al*, 2010; Rahnama *et al*, 2011).

A: If bio-photons are what results from dark photons in phase transition, the increase in alpha power and more generally in EEG power should increase bio-photon yield: BPE pumped by EEG corresponds to BPE as leakage from EEG. That there is decrease for meditators might be

related to the absence of sensory and motor mental images: if there are no mental images, there is nothing to be communicated by dark EEG photons to the personal magnetic body.

Q5. There is evidence for the conduction of bio-photons along neural fibers. Do you think it's possible that the localization of BPE during such visualization exercises is due to the photons' transmission from the brain to that affected area along efferent neurons, in the same way motor commands would be locally transmitted? Is it technically possible to measure such neural photon conduction in meditating human subjects? And should localization of action, such as targeted BPE, be part of patient training in mind-body interventions?

A: That LLLT is limited by tissue depth, ceases to be a problem if dark photons propagate along magnetic flux tubes. Darkness would provide also shield against de-coherence. One can imagine two ways to achieve targeting.

1. Password mechanism for which parts of body correspond to characteristic resonances so that dark photons with particular frequency determined by energy and value of  $h_{eff}$  are received only by that body part.
2. Second mechanism is propagation along magnetic flux tubes directed to that body part. If dark photons have cyclotron frequencies in the magnetic field of a flux tube, these mechanisms are more or less equivalent. Frequency corresponds to magnetic field strength and this in turn to thickness of magnetic flux tube. Microtubular matrix could be accompanied by magnetic flux tubes perhaps serving as a template for it. Biological effects at specific frequencies at the other end of the pathway would be the basic signature.

Q6. What do you think of target specificity in mind-matter interactions – based on your understanding of the literature, how narrowly are we able to target a particular area of the body or a particular effect? Could the differential sensitivity to LLLT on the basis of redox status or proliferation rate account for the fact that qigong-based therapies show apoptosis of tumor cells but not normal cells? What do you think is the physical basis of such differential effects, or their localization to particular areas of the body?

A: The different sensitivity of tumor cells and normal cells would be explained by different cyclotron frequencies for their magnetic bodies. The unhealthy state would be also unhealthy state of magnetic body: maybe some parts of collective magnetic body of tumor cell complex with rather large value of  $h_{eff}$  are just missing and this translates to selfish behavior of tumor cells. The claim of inventor Royal Rife (see <http://tinyurl.com/yo5yfx>) regarded as pseudoscience by the mainstream is that tumor cells can be destroyed using irradiation with specific resonance frequencies. This method must be distinguished from radiation therapy based on ionization of DNA. Rife's claim would be roughly consistent with TGD inspired proposal. Basically the challenge would be to find the frequency serving as the password to the cancer cell's magnetic body.

Q7. In your opinion what is the most likely mechanism underlying the connection between long term meditation practice and the development of healing/ psi abilities?

A: I see meditation and visualization as practices for making magnetic body more flexible. This process modifies also biological body since genetic expression is changed as magnetic body controlling the expression of genes modifies it. Also build-up of connections to the larger layers of magnetic body with large value of  $h_{eff}$  would be in question as well as developing the ability to reconnect to other magnetic bodies. The travels of meditators/shamans/etc. to other realities could involve real sensory perceptions in TGD based ontology based on same mechanisms as remote sensory experiences. In any case, the communications in shorter length scales, say inside body and to lower layers of personal magnetic body, would rely on this mechanism.

The modification of the gene expression in meditation could be interpreted as being due to the changes of the connections between magnetic body and biological body. Genetic expression could be determined by the permanent flux tube connections from the magnetic body to the promoter portions of DNA. Differentiation would select the promoters to which the magnetic body has permanent connections. The role of transmitter-receptor complex could be taken by the complex formed by the promoter and RNA polymerase making possible to receive the cyclotron radiation from the magnetic body. The model for motor action and sensory perception assumes that they are time reversals of each other so that the cyclotron radiation to genome and Josephson radiation from the cell membrane would travel in opposite time directions. In the most general case both radiations can travel in either time directions so that also cell membrane could receive control

commands (possibly interpreted as virtual sensory input giving rise to what is usually regarded as hallucinations).

The change of the gene expression would be due to a change of these connections. Both meditation, placebo effect, and healing could induce changes in gene expression in this manner. One can wonder whether this change of connections to the magnetic body can be heritable so that it would provide a new mechanism of epigenetics (examples of which are histone modification and DNA methylation). If dark photons are involved with the communications to and from the magnetic body then also BPEs as dark photon leakages would reflect the change of genetic expression.

### 7.5.2 Ii: Healing Input Parameters, Dosimetry, Research Technology

Q8. What other approaches and technologies could be used to quantify healing intent? Is there a place for operator EEG, heart rate variability, skin conductance and operator bio-photon measurements on the input side of mind-body research protocols? Should we find a correlation between healing effects and BPE intensity/frequencies, would this provide a more useful, quantitative assessment of “healer input” in mind-body methodologies than the years of meditation practice?

A: If information molecule-receptor complexes serve as bridges to magnetic body parts, the technology quantifying healing intent would involve also correlates at neuro-pharmacological level. Neuroscience and study of remote mental interactions would fuse together. Elaborate maps about the information molecule connections to magnetic body would be constructed.

Q9. Since we know the action spectra required for specific LLLT effects, would it be useful to compare these LLLT spectra to the BPE wavelengths measured outside the heads of qigong healers attempting to produce the same effects through visualization? Could we feedback-train patients to reproduce such circumcerebral frequencies through meditation?

A: The comparison of peaks of LLLT and bio-photon spectra would be very interesting. This idea can be expanded if one accepts interpretation of EEG as dark photons. The naïve prediction would be that the ratios of peak frequencies for EEG for given value of  $h_{eff}$  and for bio-photons are same. In principle (I do not know about practice) this could be tested by looking at action spectra for LLT and bio-photons!

Q10. What do you think is the mechanism through which sender-receiver bonding facilitates DMILS effects? Specifically, could we test whether healing-specific EEG frequencies and the intensity of BPE at the sender are greater when the sender has a shared history with the receiver (due to cognitive/emotional memory activation and increased neural recruitment)? Could then “pre-bonding” with a targeted tissue, such as detailed visualization of a tumor, be used to enhance the effect of a patient’s healing meditation on his own body?

A: Pre-trial bonding would translate to permanent flux tube connections between magnetic bodies due to the reconnections. This would facilitate DMILS effects: the two magnetic bodies would receive some input from each others biological bodies by dark photons, say EEG. The correlations between EEG spectra and also spectra at other frequencies could serve as a signature for this.

Q11: Could endogenous, EEG generated bio-photons be trapped and utilized as such a source of energy? And could specific forms of meditation trigger new, low-dissipation physiological configurations and metabolic pathways which would allow the capture and high-efficiency utilization of surrounding environmental photons, such as light absorbed through the eyes? How could we test for such epigenetic and molecular configuration changes?

A: The trapping of dark photons to flux tubes would look more natural than trapping of bio-photons in TGD framework. The utilization of environmental photons in Bigu does not look to me an attractive option: dark photons from magnetic body would look more natural if TGD ontology is accepted. I have considered a model for Bigu assuming that magnetic bodies serve as fundamental storages of metabolic energy. What this really means is far from obvious and several options can be imagined. The metabolic energy assigned with the covalent bonds of biopolymers could be actually cyclotron energy assignable with large  $h_{eff}$  magnetic flux tubes. Metabolism could be basically transfer or generation of negentropic entanglement assignable most plausibly to electron Cooper pairs. Bigu might reduce to sending of negative energy dark photons to some magnetic body with same cyclotron frequency (but does this generate negentropic entanglement by generating negentropic entanglement, say between electrons of Cooper pair?). This would involve

formation of reconnection to this magnetic body (same field strength, same cyclotron frequency). Negative energy photons make sense only if the arrow of geometric time (thermodynamical time) can vary, and this quite generally would make possible also instantaneous communications as reflections of signals in time direction making possible remote mental interactions with arbitrarily distant targets. Zero energy ontology guarantees this.

### 7.5.3 III: Is Placebo A Form Of Healing Intent? Placebo Genotype Vs. Phenotype

Q12: How do you physiologically interpret the recent finding that patients with a met/met COMT variant are more prone to placebo effects?

A: That persons with met/met COMT would be more prone to placebo effects than normal variant, looks at first rather weird. From Wikipedia (<http://tinyurl.com/yc5ps8pg>) one learns about the claim that people with this variant tend to feel themselves happier than those with normal variant.

If one believes that neural transmitter-receptor complex establishes a plug-in from neuron to relevant part of the magnetic body, then this does not look so weird. Methylation of DNA and proteins is a universal manner to modify the functioning of reaction pathways and appears also in epigenetics. Met/met COMT instead of Met/Val COMT could favor the generation of this kind of bridges to some parts of magnetic body with higher value of  $h_{eff}$ : if larger negentropy is responsible for feeling happiness, then the finding could be understood. The parts of the magnetic body are in one-to-one correspondence with those of brain areas and might have similar specialization to feel happy or unhappy as limbic brain is claimed to have (right limbic brain seems to be specialized in suffering!). These bridges or “plug-ins” would most naturally correspond to post-synaptic receptors for some neural transmitters - perhaps one could localize them to limbic brain.

Placebo would be self-healing based on building this kind of contacts. Healing could be seen as healing of the communications between biological and magnetic body (or bodies, say magnetic bodies of collectives).

Q13. Given the evidence that meditation produces different effects on plasma catecholamines according to BDNF or COMT polymorphisms, do you think there is there a common genetic/CNS/therapeutic pathway between placebo and healing qi ability? Could subjects' placebo and healing effectiveness be correlated with an ability to entrain massive CNS domains through both activation of broad cognitive basins (multi-sensory visualization) and emotional modules? Would certain genetic variants be more conducive to this type of CNS activation?

A: I tend to think that many pathways are involved. The pathway in question need not be the same for placebo and healing qi ability. For psychedelics and perhaps also for remote perception the pathways affecting serotonin accumulation to postsynaptic receptors seem to be important and pineal gland might be the seat of action. The general mechanism could be similar to that conjectured for the action of psychedelics/hallucinogens. The interpretation would be that connections to some parts of magnetic body or even other magnetic bodies become more stable. If information molecules and receptor proteins are crucial for building connections to the magnetic body, gene dependence is implied: biochemist could probably easily tell whether methylation is a universal mechanism for modifying these molecules.

Q14. Could certain types of meditation training replicate this effect even in subjects who do not carry the COMT met/met variant – i.e. could we train patients to “compensate” for placebo effects by long term physiological remodelling?

A: It is hard to believe that meditation would not work at all for those without met/met variant. It would only make things easier.

Q15. Would it be useful to compare the remote bio-PK ability of the two populations studied for placebo in the COMT experiment, to see if that same genetic variant may translate in a different in vitro effect size?

A: Both PK ability and placebo would involve “motor actions” of magnetic body. I however believe that the structure of hierarchy of magnetic bodies is as rich as the spectrum of neurotransmitters and other information molecules. Therefore I prefer to not answer the question!



#### 7.5.4 IV: Biophotons In Long Range Effects: DMILS From Life Precursors To Biosphere; Morphogenetic Fields, GCP, TGD

Q16. There is some evidence for remote viewing by healer and healee. Could this be due to bio-photon emissions induced through external qi?

A: The TGD expectation differs from the usual view. Dark photons is what is relevant for remote mental interactions and sending and receiving of dark photons involves leakage as bio-photons, which are ordinary photons. Various correlations between bio-photon emissions at sending and receiving ends could serve as signature for the presence of remote mental interactions, say remote viewing and healing, say correlations of temporal patterns, correlations between energies of bio-photons, and the frequencies of dark photons manifesting as EEG frequencies. Optimistically one could even expect that the ratios of peak EEG frequencies are same as those of peak bio-photon frequencies. Healing involves visualization and this might imply that also remote viewing is induced as a side product. If pineal gland functions like a “third eye” able to remote view by using dark photons instead of ordinary ones as for lower animals, its role in all remote mental actions could be important. Could this be tested by looking at what happens in pineal gland or some other brain region during remote mental interactions? Could the ability of birds and fishes to migrate to the birth places be one spectacular example of remote mental interaction? This is discussed in more detail in Appendix.

Q18. Can one imagine any technology differentiating between memory/imagination and remote perception using bio-photon profiles.

A: In TGD framework it is surprisingly difficult to distinguish between these two since also memories and vision about future can be also seen as examples of remote viewing. If fishes and birds are able to find their birth places in the manner discussed in Appendix, one would have a rather dramatic example about remote sensory perception. Hypnosis could be seen as second dramatic example of remote mental interaction.

Q19. Is the increased photon emission at living recipients due to a change in physiology? Or of energy/signature of entanglement. Stress related clinical research of meditation or research with focus on quantum non-locality?

A: TGD expectation would be that the emission would be basically due to leakage during communications to some parts of magnetic bodies involved. If one is ready to believe in dark photons and magnetic body, neuropharmacology of conscious experience and quantum non-locality inspired approach could be combined together. Questions to be asked would such as “What bio-photon energy and what ELF frequency (that is  $h_{eff}$ ) does a particular information molecule/neurotransmitter correspond to?” The hierarchy of Planck constants and the hierarchical anatomy of magnetic body would correlate with analogous hierarchy of information molecules and their receptors with neurotransmitters at top: this would mean also hierarchy at the level of cells with neurons at the top.

## Chapter 8

# Non-locality in quantum theory, in biology and neuroscience, and in remote mental interactions: TGD perspective

### 8.1 Introduction

Non-locality seems to be a basic aspect of what it is to be living. Living system is elementary particle like coherent unit. The phenomenon of memory suggests temporal non-locality. Also remote mental interactions - if real - suggest non-locality. In fact, non-locality - both spatial and temporal - is the basic element of entire quantum TGD, and in particular, of its applications to quantum biology, neuroscience, theory of consciousness, and also of remote mental interactions.

In the following I make kind of pseudo deduction of the picture provided by Topological Geometroynamics (TGD) by starting from empirical findings loosely related to non-locality rather than problems of General Relativity or of particle physics. The hope is that this could make the basic ideas of TGD easier to grasp.

#### 8.1.1 What does non-locality mean physically?

Both spatial and temporal non-locality are possible and manifested as spatio-temporal coherence not expected on basis of classical and standard QM considerations.

There are many hints about the nature of non-locality.

1. Spatial non-locality manifest itself as a coherent behavior: organisms behave like independent coherent units. The idea about sacks of water containing some chemicals able to climb in trees and write poems does not look plausible. At the level of brain spatial coherence manifests itself as synchronous behavior of brain regions.
2. Temporal non-locality manifests itself as temporal synchrony, especially so in the dynamics of brain. Also memories suggest temporal non-locality. Also various functions/behavioral patterns meaning intentional goal-directed action reflect temporal non-locality. In EEG quasi-stationary segments separated by rapid transients appear [J38].
3. Libet's findings [J19] about anomalous time ordering of conscious decision and neural correlates of associated action suggest that signals can propagate backwards in time. Motor actions would involve signals propagating backwards in time and sensory-motor dichotomy could correspond to two arrows of time.
4. Fantappie [J64] suggested long time ago that the arrow of time is not always the same in living matter and christened the entropy increasing in reverse direction of time syntropy. Spontaneous self assembly could be example of process taking place in reverse direction of

time as a decay process. This would however imply that experienced time having always the same direction cannot be equated with the geometric time. There are also other reasons for distinguishing between these two times.

**Questions:** Do we really understand the notion of time, in particular the relationship between geometric time and the experienced time? What experienced time is? Is the arrow of time always the standard one?

Temporal non-locality is very difficult if not impossible to understand in the standard physics framework, where 3-D snapshot of reality together with initial values for generalized positions and velocities determine everything. Are the basic objects 4-dimensional? Should one consider generalized positions at two values of time as basic data. Could kind of generalized Bohr orbits be in question. Could the basic entities be events - pairs of 3-D snapshot at different values of geometric time?

Should ordinary positive energy ontology (PEO) be replaced with something different, in which pairs of states - physical events - or equivalently the 4-dimensional space-time evolutions connecting them, are basic entities. One can think that these pairs of initial and final states are zero energy states in the sense that the values of various conserved quantum numbers for the positive and negative energy parts sum up to zero. This would allow to have deterministic dynamics for connecting time evolutions without loss of laws of physics. I call this ontology Zero Energy Ontology (ZEO). ZEO would be much more general than PEO but consistent with conservation laws and solve the to-be-or-not-to-be question of theoretician: why to see the pains of constructing a theory if only one particular solution of equations is realized in Nature: one cannot test the theory without additional assumptions. In ZEO based quantum theory any zero energy state could be created from vacuum.

### 8.1.2 Living systems have shape

Living organisms have shape, which is non-local property. All physical systems have shape. These shapes appear in all scales and in the case of fundamental biomolecules the shapes have crucial significance for the functioning of living matter. For instance, the dynamical folding of DNA double strand is essential for transcription.

In standard physics the shape is described in terms of densities of particles as something phenomenological. In the modelling the shape is fed in as a phenomenological geometric input and there is no attempt to really deduce the shape from microscopic physics as reductionism would demand. It is highly questionable whether this attempt could be even successful.

Could shape as something non-local be something real?

1. Geometry and topology provide two definitions of shape. Could the space-time topology and geometry - its shape - be non-trivial in even macroscopic scales? This idea does not conform with the general relativistic view according to which space-time would be topologically rather uninteresting above Planck scale. One would lose the energy momentum conservation as consequence of lost space-time symmetries (translations and Lorentz transformations). Also topology change for 3-space, which takes place routinely in living matter systems, is impossible in this framework.
2. How could one modify the general relativistic view? The hint comes from superstring models in which string world sheets are 2-D space-times represented as 2-D surfaces - sub-manifolds - in 10-D space-time. String models fail but one could perhaps modify them. The basic problem of string models is how to get the 4-D space-time from string models. Why not replace 2-D surfaces with 4-D ones in some higher-D space-time, which could be taken to be fixed because the dynamics of space-time would be coded by its geometric shape. One would avoid the notorious landscape problem and loss of predictivity.

The identification of space-time as 4-surface would change completely the view about what space-time is. The good news is that one does not lose classical conservation laws if the higher-dimensional space-time is chosen properly. Space-time surfaces can contain even Euclidian regions (time and space in the same role) without loss of basic conservation laws. This means huge flexibility.

3. The visible world is also hierarchical: shapes within shapes. Biological body consists of organs consists of cells consists of biomolecules consists of ... . This fractal like structure should have counterpart as the structure of space-time surface. Space-time surface indeed turn out to have this kind of structure: ... space-time sheets glued to larger space-time sheets glued to.... I refer to this structure as many-sheeted space-time and we indeed see it directly!

**Question:** Could space-time be 4-D surface in some higher-D space-time - many-sheeted space-time. The shape of spacetime would have meaning also as shape in this higher-D space-time.

### 8.1.3 Does coherence in long spatial and temporal scales reduce to macroscopic quantum coherence?

Coherence could be understood as macroscopic quantum coherence if living systems are macroscopic quantum systems. But how?: Planck constant is too small? There are several hints suggesting that Planck constant could have actually a spectrum.

#### Effects of ELF em fields on living matter, macroscopic quantum coherence, and dark matter and energy

The effects of ELF em fields on vertebrate brain involving both physiology and behavior look like quantal appearing at multiples of basic frequency assignable to cyclotron transitions of biologically important ions such as  $\text{Ca}^{++}$  ion in endogenous magnetic field of  $B_{end} = 2B_E/5 = .2$  Gauss, where  $B_E = .5$  is the nominal value of Earth's magnetic field [J27] The problem is that cyclotron energies are extremely low: more than ten orders of magnitude below thermal energies.

**Question:** Could Planck constant have nonstandard values: say  $h_{eff} = n \times h$ .

If this were the case, quantum scales would be scaled up. Energy  $E = h_{eff}f$  associated with given frequency is scaled up. Could EEG consist of photons with  $h_{eff} = n \times h$  such that the energies of dark EEG photons are above thermal energies. These photons can transform to ordinary photons perhaps identifiable as bio-photons in the energy range of visible and UV photons.

What these phases of matter with non-standard Planck constants could be? Why we have not observed them? We know that dark energy and dark matter exist. Could they correspond to  $h_{eff} = n \times h$  phases? If so, dark matter could be in key role in living matter. Two mysteries would find a common explanation.

**Question:** Should one generalize quantum theory so that dark matter/energy would be assignable to hierarchy of  $h_{eff} = n \times h$  phases?

#### Where could the dark matter reside?

Where could the dark matter reside?

1. The first hint comes from quite recent finding that the brain hemispheres of persons having no corpus callosum are in synchrony (see <http://tinyurl.com/3gjhtgb>). What synchronizes the brain hemispheres in this kind of situation? The hint comes from spontaneous synchronization of clocks (penduli) involving generation of very weak periodic perturbation - "boss" - forcing the clocks in same phase. Is there a kind of "boss", which forces neurons to march in synchrony [K69]?
2. Second hint comes from the observation that EEG correlates strongly with the contents of consciousness. Why? Information costs energy. Why to construct information not used for any purpose? Could it be that EEG communicates information about brain state to some entity? Could this entity be the "boss" in turn using EEG to control the brain. The wavelength associated with EEG frequency 7.8 Hz is circumference of Earth. Could this entity be of this size or even larger?
3. There is a further hint: the effects of ELF radiation were at cyclotron frequencies in endogenous magnetic field with strength of .2 Gauss. For iron it corresponds to 10 Hz frequency for which wavelength is slightly larger than circumference of Earth. Could the "boss" be a magnetic field structure - magnetic body (MB) - assignable to the organism?

4. There is an objection against this idea. In Maxwell's electrodynamics magnetic fields of different organisms interfere to a random background so that the informations from separate organisms would be lost. Standard space-time concept is not enough. Should the very notion of space-time be such that the magnetic field structures of different organisms behave like separate entities without interference between them. The phases of matter with different values of  $h_{eff}$  would in some sense live in different worlds - they would be dark relative to each other - but also interact with matter visible to us. Generalization of space-time concept seems to be necessary. The guess is many-sheeted space.

**Question:** Do magnetic bodies carrying dark matter characterized by non-standard value of Planck constant carry serve as "bosses"? They should also effectively correspond to separate space-times.

### How to create dark matter?

One eventually encounters the question how to test the theory. To achieve this one should be able to create dark matter by inducing phase transition of ordinary matter to dark matter or to do the opposite: ordinary matter would mysteriously disappear somewhere or pop up somewhere. This would serve as a signature for the dark matter. There are some hints.

1. Biosystems look like critical systems. Sensory systems have optimal sensitivity to small changes in environment. There is analogy with fundamental physics: in particle accelerators measurement instruments are critical systems to maximize the sensitivity and transform microscopic effects to macroscopic ones. Neural system is an excellent example of a control system in which small control signals give rise to large effects. Homeostasis can be understood in terms of positive and negative feedback keeping the system near criticality. Living systems are functional in rather narrow temperature range. There is also evidence for quantum criticality (QC) at molecular level [I41].
2. The appearance of  $h_{eff} = n \times h$  dark matter should lead to a generation of long range coherence and non-locality. On the other hand, long range fluctuations are the tell-tale signature of criticality. Could dark phases with  $h_{eff} = n \times h$  be created at quantum criticality (QC)?

**Question:** IS QC is essential for having non-locality manifesting itself as long range correlations, dark matter, and  $h_{eff} = n \times h$  phases.

### 8.1.4 Summing up

To sum up: these propagandistic arguments suggest the following picture.

1. Temporal non-locality requires that PEO is replaced ZEO. The arrow of time is not always the same. The relationship between experienced and geometric time must be understood: they are not same although they are strongly correlated.
2. The importance of shape - a non-local concept - in biology suggests identification of space-time as 4-D surface in some higher-D space-time.
3. EEG contains information about the contents of consciousness: EEG communicates information to some entity identified as magnetic body serving as intentional agent receiving sensory input and controlling biological body. The organism-environment duality would be replaced with trinity involving also MB.
4. Coherence in long scales reduces to quantum coherence for  $\rightarrow h_{eff} = n \times h$  dark matter hierarchy and dark matter at magnetic bodies is the quintessence of living matter.
5. Criticality of living matter reduces to long range correlations implied by QC. Dark matter is created at QC and implies also non-locality.

The challenge is to realize this picture mathematically. TGD does this although I ended up with it with motivations coming from General Relativity and particle physics. In the sequel I discuss the mathematical formulation and its physical interpretation. I also discuss briefly various applications of this picture.

## 8.2 TGD

General theory of relativity (GRT) plagued by the problem that the notions of energy and momentum are not well-defined for curved space-time. The proposal for overcoming the energy problem (made 1977, thesis came 1982) was that space-times are not abstract 4-D manifolds but representable as 4-D surfaces in certain 8-dimensional space-time  $H = M^4 \times CP_2$ , which is empty Minkowski space  $M^4$  with points replaced with certain very small 4-D space  $CP_2$  fixed uniquely from the condition that standard model symmetries and standard model fields can be geometrized. This choice of  $H$  is uniquely fixed both by twistorial considerations [K101, K35] or by the condition that theory is consistent with standard model symmetries.

It soon turned out that the modification can be seen also as a generalization of string model with strings in 10-D space-time replaced with 3-D surfaces in 8-D  $H$ , whose “orbits” are identifiable as space-time surfaces. Recently the connection with string model picture has become much deeper. By strong form of holography (SH) 2-D string world sheets and partonic 2-surfaces carry the data needed to construct quantum states and construct solutions of field equations (preferred extremals). 4-D space-time is however necessary for quantum-classical correspond necessary to describe measurements.

TGD Universe is predicted to be fractal: this replaces the naïve Planck length scale reductionism with fractality for which the simplest realization would be p-adic length scale hypothesis emerging from p-adic thermodynamics and dark matter hierarchy. Non-trivial predictions emerge in all scales from Planck length to cosmology and this makes it very difficult to communicate TGD for colleagues believing firmly on naïve length scales reductionism.

In what follows I will proceed from quantum TGD to classical TGD without starting from particle physics observations - it would be extremely boring to repeat same old arguments again and again and reader can find these arguments from [K111].

### 8.2.1 Quantum TGD

The basic idea is to generalize Einstein’s program as geometrization of classical physics to geometrization of the entire quantum theory so all notions of quantum theory except state function reduction which is identified as basic building brick of conscious experience would reduce to geometry.

#### Reduction of quantum theory to Kähler geometry and spinor structure of WCW

The condition that the entire quantum theory is geometrized requires infinite-dimensional geometric structure instead of space-time and the “world of classical worlds” (WCW) identified roughly as the space of space-time surfaces is the natural identification [K22, K42].

1. The construction of quantum TGD leads to a generalization of the notion of super-space of Wheeler and to construction of infinite-dimensional geometry that I call “World of Classical Worlds” (WCW) having rough mathematical identification as space of 3-surfaces in  $H$  (ZEO dictates the identification in more detail). The mere mathematical existence of WCW geometry fixes it essentially uniquely - this is true already for the loop spaces of string model [A7] - and therefore physics. A huge generalization of the symmetries of super-string models emerges giving hopes of understanding the theory.

The geometrization of hermitian conjugation of quantum theory requires that WCW allows complex structure its metric is Kähler metric [K42] and coded by Kähler function identified in terms of Kähler action for a preferred extremal: this gives direct connection with classical physics since induced Kähler form define classical U(1) field, for the U(1) factor of electroweak gauge group assignable with weak hyper-charge. twistor lift implies the presence of a volume term identifiable in terms of cosmological constant. It would bring also Planck length into the theory as the radius of twistor sphere [K101].

2. Quantum states are identified as classical WCW spinor fields so that there is no need to perform quantization and state function reduction is the only genuinely quantal aspect of TGD [K110, K81]. Spinor structure requires identification of gamma matrices anticommute to WCW metric and if the metric is Kähler metric, the anti-commutation relations are

completely analogous to those of fermionic oscillator operators and one can indeed express the gamma matrices as linear superpositions of fermionic oscillator operators at space-time surface. Second quantization at space-time level is a purely classical notion at WCW level and becomes geometrized in WCW context.

3. ZEO (Zero Energy Ontology) is an essential element of theory. Usually one assumes that in classical physics generalized positions and their time derivatives (generalized velocities) giving at given moment of time in 3-D snapshot of space-time dictated the time evolution. This has generalization to Schrödinger equation. One has initial value problem.

This Newtonian view does not work in TGD: boundary value problem provides a more natural formulation. The generalized positions at two moments of time are more natural data and the dynamical evolution connecting the two 3-D snapshots defines by holography more or less equivalent view about the situation. These pairs are analogous to classical events and one can construct as their quantum superpositions what I call zero energy states and quantum jumps are quantum events occurring between these classical events.

ZEO is much more flexible than ordinary ontology since any zero energy state can be created from vacuum whereas in standard classical ontology only one solution of field equations is realized and in principle it is not possible to test the theory without additional assumptions. ZEO is especially natural in biology and neuroscience: the notions like function, behavioral pattern, and habit are not easy to describe in terms of the state of organism as 3-D snapshot of time evolution.

The two time=constant snapshots are actually replaced with past and future boundaries of CD, which is the intersection of future and past directed light-cones of Minkowski space with each point replaced with  $CP_2$ . The ends of space-time surfaces are at the these boundaries. Zero energy states have opposite conserved quantum numbers at the opposite boundaries of CD: this guarantees that conservation laws are satisfied and the system is consistent with standard laws of physics. CDs form a fractal hierarchy. There are CDs within CDs and CDs can also overlap.

In order to avoid confusion it must be made clear that since WCW spinor fields and zero energy states are formally purely classical entities. Only the state function reduction replacing zero energy state (classical event) would be genuinely quantal element of the theory. The Wheelerism for this would be “Quantization without quantization”.

4. The recent formulation for the notion of preferred extremal relies on strong form of General Coordinate Invariance (SGCI). SGCI states that two very different kinds of 3-surfaces can be identified as fundamental objects. Either the light-like 3-D orbits of partonic 2-surfaces defining boundaries between Minkowskian and Euclidian space-time regions or the space-like 3-D ends of space-time surfaces at boundaries of CD (both ends!). If both choices are equally good, partonic 2-surfaces and their tangent space-data at the ends of space-time should be the most economic choice.

This eventually led to the realization that partonic 2-surfaces and string world sheets should be enough for the formulation of WCW geometry and quantum TGD [K21]. Classical fields in the interior of space-time surface would be needed only in quantum measurement theory, which demands classical physics in order to interpret the experiments. The outcome is SH stating that quantum physics should be coded by string world sheets and partonic 2-surfaces inside given CD. SH is very much analogous to the AdS/CFT correspondence but is much simpler: the simplicity is made possible by much larger group of conformal symmetries. 2-dimensionality of space-time regions carrying fermion field can be deduce also from the condition that electromagnetic charge is well-defined for spinor modes: this requires that W boson fields vanish and this implies in the generic case 2-D string world sheets. Number theoretic vision suggests the interpretation of string world sheets and partonic 2-surfaces as commutative or co-commutative sub-manifolds of the space-time having quaternionic (associative) tangent space as a 4-surface in the embedding space with octonionic (non-associative) tangent space [K94, K108].

If these 2-surfaces satisfy some consistency conditions one can continue them to 4-D space-time surface inside CD such that string world sheets are surfaces inside them satisfying

the condition that charged (possibly all) weak gauge potentials identified as components of the induced spinor connection vanish at the string world sheets and also that energy momentum currents flow along these surfaces. String world sheets carry second quantized free induced spinor fields and fermionic oscillator operator basis is used to construct WCW gamma matrices.

5. The existence of WCW geometry requires maximal possible group of symmetries for the geometry of WCW. Essentially a union of infinite-dimensional symmetric spaces labelled by so called zero modes not contribution to the line element of WCW would be in question. The natural candidate for this infinite-dimensional isometry group is symplectic group acting in  $CP_2$  and at 3-D light-cone. This group maps vacuum extremals to vacuum extremals but is not a symmetry of more general extremals: if this were the case WCW metric would be trivial.

### Quantum Criticality and hierarchy of Planck constants as dark matter hierarchy

The Kähler coupling strength  $\alpha_K$  appearing in Kähler action is analogous to temperature. In its original form [K42] QC stated that this coupling strength is analogous to critical temperature and therefore has discrete spectrum. This idea makes sense even if Kähler action is generalized to contain additional terms: all coupling constants would be analogous to critical thermodynamical parameters.

Indeed, the twistor lift of TGD [K101, K35] replacing space-time surfaces with their twistor spaces in 12-dimensional product of twistor spaces of  $M^4$  and  $CP_2$  indeed brings in cosmological constant  $\Lambda$  and Planck length as radius of the sphere  $S^2$  serving as the fiber of twistor space. This lift makes sense only for  $M^4 \times CP_2$  making this choice unique. If Planck length and cosmological constant emerge in this manner their spectrum would be fixed by QC condition. The negative pressure implying accelerated cosmic expansion can be also assigned to magnetic flux tubes with monopole flux so that the situation remains open.

The meaning of QC at the level of dynamics has become only gradually clearer. The development of several apparently independent ideas generated for about decade ago have led to the realization that QC [?] is behind all of them. Behind QC are in turn number theoretic vision and strong forms of general coordinate invariance (GCI) and holography (SGCI and SH).

1. The hierarchy of Planck constants labelling a hierarchy of dark phases of ordinary matter corresponds to a hierarchy of quantum criticalities assignable to a fractal hierarchy of sub-algebras of the super-symplectic algebra assignable to the boundary of CD with points replaced with  $CP_2$ . The conformal weights are  $n$ -ples of those for the entire algebra. These algebras are isomorphic to the full algebra and act as gauge conformal algebras so that a broken super-conformal invariance is in question. For  $n > 1$  the hierarchy levels are interpreted in terms of dark matter. What is highly non-trivial that the conformal weights itself need not be integers or half integers as usually. The generators of algebra could have conformal weights which are proportional to zeros of zeta and poles of zeta so that the number of generating elements (finite for ordinary super-conformal algebras) would be infinite [K32]. Physical states would however have real conformal weights which would be half integers (conformal confinement).

Could  $n$  correspond to the value of effective Planck constant  $h_{eff}/h = n$ ? Why  $n$  should correspond to the number of sheet for the space-time surface as covering space? It has become clear that there is no obvious reason why for this. Number theoretic vision provides much more feasible answer. Adelic hierarchy corresponds to a hierarchy of extensions of rationals and the Galois groups of extensions act as symmetry groups permuting number theoretic discretizations of space-time surface and combining them to single  $n$ -fold covering space, where  $n$  divides the the order of Galois group of the extension. These groups also act as automorphism groups of the dynamical Kac-Moody groups assignable to the hierarchy of sub-algebras of the super-symplectic algebra.

2. QC in turn reduces to the number theoretic vision about SH. String world sheets carrying fermions and partonic 2-surfaces are the basic objects as far as pure quantum description is considered. Also space-time picture is needed in order to test the theory since quantum



measurements always involve also the classical physics, which in TGD is an exact part of quantum theory.

SH says that space-time surfaces are continuations of collections of string world sheets and partonic 2-surfaces to preferred extremals of Kähler action for which Noether charges in the sub-algebra of super-symplectic algebra vanish. This condition is the counterpart for the reduction of the 2-D criticality to conformal invariance. This eliminates huge number of degrees of freedom and makes SH possible. TGD does not reduce physics to that of strings since the fact that strings are surfaces inside 4-D space-time surfaces is an essential part of physics and also the experimental testing requires 4-D space-time as also the notion of 8-D embedding space.

3. The hierarchy of algebraic extensions of rationals defines the values of the parameters characterizing the 2-surfaces, and one obtains a number theoretical realization of an evolutionary hierarchy. One can also algebraically continue the space-time surfaces to various number fields - reals and the algebraic extensions of p-adic number fields. Physics becomes adelic [K108].

p-Adic sectors serve as correlates for cognition and imagination. One can indeed have string world sheets and partonic 2-surfaces, which can be algebraically continued to preferred extremals in p-adic sectors by utilizing p-adic pseudo constants providing huge flexibility. If this is not possible in the real sector, a fragment of imagination is in question! It can also happen that only part of real space-time surface can be generated: this might relate to the fact that imaginations can be seen as partially realized motor actions and sensory perceptions.

4. The assignment of the hierarchy of Planck constant to a hierarchies of inclusions of hyperfinite factors of type  $II_1$  is natural. Also the interpretation in terms of finite measurement resolution makes sense. As  $n$  increases the sub-algebra acting as conformal gauge symmetries is reduced so that some gauge degrees of freedom are transformed to physical ones. The transitions increasing  $n$  occur spontaneously since criticality is reduced. A good metaphor for TGD Universe is as a hill at the top of a hill at the top.... In biology this interpretation is especially interesting since living systems can be seen as systems doing their best to stay at criticality using metabolic energy feed as a tool to achieve this. Ironically, the increase of  $\hbar$  would mean increase of measurement resolution and evolution!
5. If twistor lift is not performed, the only coupling constant of the theory is Kähler coupling constant  $\alpha_K = g_K^2/4\pi\hbar$ , which appears in the definition of the Kähler function  $K$  characterizing the geometry of WCW. In the most general case  $\alpha_K$  has a spectrum of critical values and this conjecture seems at this moment the most reasonable one. It has indeed turned out that the discrete spectrum could have interpretation in terms of discretized coupling constant evolution for U(1) coupling constant of standard model. The identification of the spectrum in terms of zeros of so called fermionic zeta function expressible in terms of Riemann zeta is attractive [K32]. The exponent of  $K$  defines vacuum functional analogous to the exponent of Hamiltonian in thermodynamics. The allowed values of  $\alpha_K = g_K^2/4\pi\hbar_{eff}$  should be analogous to critical temperatures and determined by QC requirement.

### 8.2.2 Classical TGD

In TGD framework classical physics is an exact part of quantum physics rather than being only an approximate limit of quantum theory emerging from the stationary phase approximation to path integral, which would in TGD allow all space-time surfaces. Now one does not have path integral but functional integral over the pairs of 3-surfaces at boundaries of CD. Only preferred extremals of Kähler are allowed in the functional integral so they satisfy classical field equations and even more: effective 2-dimensionality holds by SH. Stationary phase approximation can be made also now but selects "preferred preferred extremals". The reason is that for real value of  $\alpha_K$  the Minkowskian space-time regions give imaginary exponent to the action exponential whereas Euclidian space-time regions give real exponent identifiable as exponent of Kähler function. In fact, the value of  $\alpha_K$  can be also complex but this does not affect this picture.

### Space-time surfaces as preferred extremals of Kähler action

Preferred extremal of Kähler action have remained for a long time one of the basic poorly defined notions of TGD. There are pressing motivations for understanding what “preferred” really means. For instance, the conformal invariance of string models naturally generalizes to 4-D invariance defined by quantum Yangian of quantum affine algebra (Kac-Moody type algebra) characterized by two complex coordinates and therefore explaining naturally the effective 2-dimensionality [K101].

In ZEO preferred extremals are space-time surfaces connecting two space-like 3-surfaces at the ends of space-time surfaces at boundaries of CD. A natural looking condition is that the symplectic Noether charges associated with a sub-algebra of symplectic algebra with conformal weights  $n$ -multiples of the weights of the entire algebra vanish for preferred extremals. These conditions would be classical counterparts the condition that super-symplectic sub-algebra annihilates the physical states.

What is needed is the association of a unique space-time surface to a given 3-surface defined as union of 3-surfaces at opposite boundaries of CD. One can imagine many ways to achieve this. “Unique” is probably too much to demand: for the proposal unique space-time surface is replaced with finite number of conformal gauge equivalence classes of space-time surfaces. This would bring in finite number of discrete degrees of freedom. In any case, it is better to talk just about preferred extremals of Kähler action and accept as the fact that there are several proposals for what the precise meaning of this notion.

### Many-sheeted space-time and topological field quantization

At classical level the basic is the notion of many-sheeted space-time which can be visualized in 2-D situation as a structure consisting of space-time sheets extremely near to each other and connected by wormhole contacts. General Relativity becomes approximate description obtained by replacing the sheets with single slightly curved region of Minkowski space. The sheets correspond to material objects that one can say that we directly see them. The experimental tests distinguishing TGD from GRT relate to many-sheetedness.

Preferred extremal property implies extremely powerful quantization conditions as is clear from the fact that the 2-D data should fix the preferred extremal by SH.

The quantum field theory limit of TGD - GRT plus standard model - is obtained when the sheets are compressed to single region of slightly curved piece of  $M^4$  by identifying gauge potentials as sums of induced gauge potentials for the spinor connection of  $CP_2$  and gravitational field as sum for the deviations of the induced metrics from Minkowski metric. This corresponds to the vision that the force experienced by a test particle - small 4-surface - is sum of those induced as it touches various space-time sheets. One gets rid of topological complexity but the extreme simplicity of space-time dynamics is lost in this replacement.

The compactness (finite size)  $CP_2$  implies topological field quantization: the classical electric fields, magnetic fields, and radiation fields decompose to topological field quanta, space-time sheets, and one can say that physical systems have field identity, field body. This is not true in Maxwell’s theory.

The notion of magnetic body carrying dark matter identified as macroscopically quantum coherent  $h_{eff} = n \times h$  phases has become central in TGD inspired quantum biology [K70, K69]. Magnetic body becomes intentional agent using biological body as a sensory receptor and motor instrument. Communication and control would be based EEG and its fractally scaled variants consisting of dark photons. The size of magnetic body is rather large, at EEG frequency range the size scale is defined by the wave length of photons involved and is of the order of the size scale of Earth. The proposal is that bio-photons are created in a phase transition transforming dark photons to ordinary photons [K10]: since bio-photons have energies are in the range of visible and UV photons, this requires that the value of  $h_{eff}/h$  is roughly the ratio of the frequency of EEG photon with the frequency of visible photon and rather large.

I have called radiation quanta “massless extremals” (MEs) or topological light rays. For MEs the signals propagate at maximal signal velocity (for general space-time sheet light velocity is reduced since the paths along curved space-time sheet is general longer) and thanks to the tubular structure of ME they represent precisely target communications. A further property is that the shape of signal is preserved since positive frequency can propagate in one direction only.

### New ontology

TGD leads to a new ontology at both space-time level and quantum level.

1. At space-time level many-sheeted space-time represents new piece of ontology. Single space-time sheet is extremely simple objects and the information needed to construct it is by SH 2-dimensional. Complexity emerges at quantum field theory limit when the sheets of the many-sheeted space-time are replaced with single slightly curved region of  $M^4$ .
2. The hierarchy of Planck constants identified in terms of dark matter as phases of ordinary matter represents second new ontological element. Dark matter is assumed to reside at magnetic body which also represents a new ontological element.
3. A further modification of ontology is the replacement of the usual positive energy ontology (PEO) with what I call ZEO already described. In ZEO quantum states are superpositions of quantum evolutions connecting the positive and negative energy parts of the states. Zero energy states are essentially 4-D and only the positive and negative energy parts are 3-D. Quantum jumps/state function reductions re-create the zero energy states with new ones and this allows to solve the basic paradox of ordinary quantum measurement theory due to the fact that non-determinism of state function reduction is in conflict with the determinism of unitary time evolution. One also ends up with identification of "self" as conscious entity: self corresponds to generalized Zeno effect: to a sequence of state function reduction to say positive (positive) energy part of zero energy state [K6] [L30]. Self dies when the first reduction to negative (positive) part occurs. Also the origin for the flow of experienced time can be understood.

### Hierarchies

TGD Universe is characterized by various hierarchies. At space-time level there is a hierarchy of space-time sheets labelled by a hierarchy of p-adic length scales coming as primes near powers of two and probably generalizing to primes near powers of prime [K58, K108]. In ZEO and at embedding space level there is a hierarchy of CDs labelled by their size scales coming as integer multiples of  $CP_2$  scales. The fractal hierarchy of symplectic sub-algebras leads to a generalization of quantum theory based on a hierarchy of Planck constants characterizing hierarchy of dark matters [K33, ?], hierarchies of inclusions of hyper-finite factors [K109], hierarchies of breakings of super-symplectic gauge symmetry [K110, K81] associated with a hierarchy of quantum criticalities [?]. There is also a number theoretic hierarchy of algebraic extensions of rationals accompanied by those of p-adic number fields [K108] allowing to see evolution as a gradual increase of the complexity for extensions of rationals assignable to the parameters characterizing string world sheets and partonic 2-surfaces. In TGD inspired theory of consciousness [K50] self hierarchy emerges.

At the basic level the fundamental hierarchy seems to be the hierarchy of breakings of super-symplectic symmetry as gauge symmetry. Super-symplectic algebra and its Yangian generalization have the structure of conformal algebra and is naturally associated with critical systems which are now 4-dimensional. There are also other conformal algebras involved.

By SH implied by the SGCI the core of the mathematical description of quantum TGD reduces to that for 2-D systems associated with partonic 2-surfaces and string world sheets. Although space-time is 4-D, all that can be said mathematically about quantum physics can be reduced to these 2-D "space-time genes". 4-D space-time surfaces are however necessary for the classical description of TGD necessary to interpret quantum measurements in terms of frequencies and wavelengths classical space-time picture about particles. This reduction implies that the representations of charges of super-symplectic Yangian [K101, K35] are in terms of fermionic strings connecting partonic 2-surfaces, which means enormous simplification of the theory. This representation also involves a generalization of AdS/CFT duality to TGD framework as manifestation of SGCI basically [K21].

#### 8.2.3 Number theoretical physics

Number theoretical physics involves several threads [K108].

1. p-Adic physics as correlate for cognition, imagination, and intentionality [K93] p-Adic physics was originally inspired by the challenge of understanding the mass scales of elementary particles but it soon turned that the interpretation in terms of mathematical correlates of cognition and imagination is very natural. This in turn forced the conclusion that cognition is probably present in all length scales, rather than only at the level of brain. The eventual outcome was a fusion of real and p-adic physics in terms of adelic physics.
2. Classical number fields emerge very naturally in TGD framework [K94]. For instance, the conjecture is that space-time surfaces as preferred extremals of Kähler action are quaternionic sub-manifolds of embedding space endowed with octonionic structure. Also quaternion analyticity [A19, A14] as a generalization of complex analyticity central in string models is very attractive conjecture [K101] in accordance with the original vision that 2-D analyticity in some sense generalizes to its 4-D variant.
3. Infinite primes [K92] are constructed by a repeated second quantization of arithmetic quantum field theory and could be essential for understand of quantum TGD.

In the sequel I discuss only the p-adic physics and the fusion of real physics and various p-adic physics to adelic physics as proposal for the physics of matter and mind or correlates of sensory and cognitive consciousness.

#### p-Adic physics as physics of cognition, imagination and intentionality

1. The attempt to understand elementary particle mass spectrum led to the hypothesis that p-adic number fields - one for each prime  $p = 2, 3, 5, \dots$ , which are completions of rationals like real numbers, allow to construct what I called p-adic thermodynamics allowing to understand particle masses as kind of thermal masses resulting when massless particles suffer slight thermal mixing with particles with mass scale given by  $CP_2$  mass of order  $10^{-4}$  Planck masses.
2. The failure of well-orderedness property for p-adic numbers brings in the corresponding failure due to a finite measurement resolution and leads to the vision that p-adic numbers are ideal for describing the effects of finite measurement resolution and cognitive resolution.
3. The failure of strict determinism for the partial differential equations suggest strongly that it serves as a correlate for cognition, imagination, and maybe also intention is closely related.
4. The fusion of real physics and various p-adic physics (identified as correlates for cognition, imagination, and intentionality) to single coherent whole leads to adelic physics [K108]. Adeles associated with given extension of rationals are Cartesian product of real number field with all p-adic number fields extended by the extension of rationals. Besides algebraic extensions also the extension by any root of e is possible since it induces finite-dimensional p-adic extension. One obtains hierarchy of adeles and of corresponding adelic physics interpreted as an evolutionary hierarchy.

An important restriction is that p-adic Hilbert spaces exist only if one restricts the p-adic numbers to an algebraic extension of rationals having interpretation as numbers in any number field. This is due to the fact that sum of the p-adic valued probabilities can vanish for general p-adic numbers so that the norm of state can vanish. One can say that the Hilbert space of states is universal and is in the algebraic intersection of reality and various p-adicities.

5. One can define the p-adic counterparts of Shannon entropy for all finite-dimensional extensions of p-adic numbers, and the amazing fact is that these entropies can be negative and thus serve as measures for information rather than for lack of it. The formula is simple:

$$S = - \sum_k P_k \log(P_k) \rightarrow \sum_k P_k \log(N_p(P_k)) . \quad (8.2.1)$$

Here  $N_p(x)$  is the p-adic norm, which for  $n$ -D extension is defined as  $n$ :th root of the determinant of the matrix of the linear map defined by multiplication with  $x$ . The change of sign is dictated by the fact that converging Boltzmann weights  $e^{-E/kT}$  must in be TGD proportional to positive powers  $p^k$  with increasing  $k$  by the properties of p-Adic norm.

p-Adic entropy can have both signs bit NMP suggests that the sign tends to become negative so that interpretation as a measure for conscious information is possible. Furthermore, all non-vanishing p-adic negentropies are positive and the number of primes contributing to negentropy is finite since any algebraic number can be expressed using a generalization of prime number decomposition of rational number. These p-adic primes characterize given system, say elementary particle.

The possibility of NE together with NMP [K52] implies that the reduction does not always lead to an unentangled state but can generate NE. Living systems would be systems generating NE and biological evolution could be seen as a gradual generation of negentropic resources - I have called them Akashic Records. For rational probabilities entanglement negentropy equals to real entropy [L26]. This might relate to the Jeremy Englands vision that high entropy is relevant for living matter.

What is important that entanglement negentropy and thermodynamical entropy are *not* negatives of each other. Hence NMP is not in conflict with the second law but predicts it for the ordinary matter as a consequence of non-determinism of state function reduction. It is however true that large entropic recources realized as a large number of states with the same energy makes possible both large thermodynamical entropy and NE with large negentropy.

### The extension of real physics to adelic physics

In TGD framework cognition is described in terms of p-adic number fields and has led to a fusion of real and various p-adic physics to what I call adelic physics [K108]. Real physics corresponds to sensory experience and p-adic physics to cognition and imagination. Originally I talked about p-adic physics as physics of cognition and intentionality but I have have become ambivalent about intentionality: this issue remains unsettled.

Real-p-adic correspondence has been a longstanding problem. Continuous correspondence at space-time level does not respect symmetries. Algebraic correspondence respects symmetries but not continuity. Also GCI has been a problem. In the proposed framework real-p-adic correspondence can be realized in elegant manner without conflict with fundamental symmetries and achieving continuity only for discretization.

1. The naïve idea is that rationals belong to the intersection of reals and p-adics. More generally, points in algebraic extension of rationals would be common to realities and p-adicities which correspond to “thought bubbles” or imaginations. This hierarchy defines a hierarchy of adeles having interpretation in terms of evolution leading to increasingly complex algebraic extensions of rationals.
2. The first guess was that this means at space-time level that embedding space points with rational valued coordinates (or values in the extension of rationals) correspond to common points of real and p-adic space-time surfaces. This picture however leads to problems with both GCI and key symmetries of TGD. What are the preferred coordinates of space-time surface which would be in algebraic extension of rationals in the intersection? Should one restrict symmetry groups to their discrete subgroups?
3. A partial resolution of the problem came from the realization that the intersection of realities and p-adicities corresponds to space-time surfaces, whose representation is such that they make sense both in real and p-adic sense [K108]. This requires that the WCW coordinates of these surfaces are invariant under various symmetries and general coordinate transformations of space-time belong to the extension of rationals in question. At the level of WCW the coordinates are highly unique on basis of symmetries and by GCI at space-time level. This also means discretization of the infinite-dimensional WCW and together with huge isometry group of WCW gives hopes about computability of TGD.

4. As often happens, also the original idea about points of given algebraic extension of rationals as common to real and p-adic space-time surfaces makes sense: one can say that these discrete points define cognitive representations in the real world. The point is that space-time surfaces can be identified as 4-surfaces in  $H$  and discretization is induced by that of  $H$ . At the first step, the pieces of hyperboloids inside  $CD$  and  $CP_2$  can be replaced with their discrete variants making sense both in real and p-adic sense [L29].

The discretization of space-time surface is *induced* by the discretization at the level of  $CD \times CP_2$  in terms of algebraic points of space-time surface and one avoids problem with p-adic version of general coordinate invariance and various space-time symmetries because for coset spaces the coordinate choice is unique apart from isometries: angles or hyperbolic angles serve as coordinates. Angles do not exist in p-adic context. The phases  $exp(i\phi)$  - and therefore the values of trigonometric functions - exist in algebraic extensions of p-adic numbers as roots of unity associated with angles  $\phi_{m,n} = m2\pi/n$ . Also the roots  $e^{m/n}$  define finite-D extension of p-adic numbers since  $e^p$  is ordinary p-adic number.

The outcome is a precise mathematical formulation for the p-adic counterparts of space-time surfaces as preferred extremals of Kähler action. The p-adic variants of coset spaces can be seen as discretizations of real coset spaces with discrete points replaced by p-adic continua analogous to the monads of Leibniz [L29]. This would make possible discretization without loosing differentiability central for field equations. One can define p-adic field equations inside these monads and strong SH makes sense in both real and p-adic sector.

The same algebraic expressions would describe real and p-adic solutions of field equations locally when restricted to string world sheets and partonic 2-surfaces (maybe also their light-like orbits). Inside monads real-p-adic correspondence would respect algebraic structures and symmetries. In the intersections symmetry groups would be replaced with discrete subgroups and continuity would be respected in the approximation provided by discretization and would confirm with the idea about finite measurement resolution.

5. This procedure is unique for given choice of discrete subgroups  $G$  and  $H$ . One can however take any discrete subgroup with matrix elements in algebraic extension of rationals and its subgroup and form a discrete analog of coset space: there is infinite hierarchy of measurement/cognitive resolutions. For instance, in the case of  $SU(2)$  these discrete approximations of  $SU(2)$  containing finite set of points correspond to the discrete subgroups labelling inclusions of hyperfinite factors of type  $II_1$  and include only Platonic solids as genuinely 3-D approximations of sphere. This is discrete structure in real world.

### p-Adic physics as physics of imagination

A further step in the progress came from the discovery of SH [K21]. 2-dimensional surfaces (string world sheets and partonic 2-surfaces) are fundamental objects and 4-D physics is a kind of algebraic continuation from this intersection of reality and various p-adicities in both real and p-adic sectors of the adelic Universe. 4-D space-time surfaces are preferred extremals of Kähler action making them effectively 2-D in the sense that the 2-D surfaces serve as “space-time genes”. Also the quantum states assignable to the 2-D surfaces can be algebraically continued to the entire 4-D space-time.

It is however quite possible that the continuation in the real sector to a preferred extremal of Kähler action fails. In p-adic sectors the possibility of p-adic pseudo constants, which are piecewise constant functions with vanishing derivative, makes the continuation much easier. This inspires the idea that imagination corresponds to these p-adic continuations. p-Adic continuation might be possible whereas real continuation could fail: one would have imagined world, which cannot be realized as often happens!

This argument becomes more precise as one realizes that SH is slightly broken: even information theoretically one has only effective 2-dimensionality [K108]. This means that 4-surfaces as preferred extremals are dictated by the data at string world sheets and possibly also partonic 2-surfaces and by data discrete set of points with preferred embedding space coordinates in the extension of rationals defining the adelic structure by inducing the extensions of p-adic number fields. For p-adic number fields pseudo-constants make it easy to construct the algebraic continuation to

a preferred extremal containing the discretization. For reals this is possible only in special cases. These discretizations correspond to realizable imaginations.

Note that Galois group acts as symmetries in the space of space-time discretizations and under certain conditions gives rise to a space-time surface, which is a covering space with  $n$  sheets,  $n$  a factor of the order of Galois group. The identification  $h_{eff}/h = n$  is natural and reduces the hierarchy of Planck constants and dark matter to adelic physics. Ramified primes for the extension of rationals involved are preferred for extension and if the extension allows especially many realizable imaginations, it is survivor in the number theoretic fight for survival. Ramified primes for these extensions should be winners in the number theoretic evolution. Whether p-adic length scale hypothesis and its generalization follow from this conjecture, remains an open question.

### Negentropic entanglement (NE)

In a given p-adic sector the entanglement entropy is defined by replacing the logarithms of probabilities in Shannon formula by the logarithms of their p-adic norms as already described. The resulting entropy satisfies the same axioms as ordinary entropy but makes sense only for probabilities, which are rational valued or in an algebraic extension of rationals. The algebraic extensions corresponds to the evolutionary level of system and the algebraic complexity of the extension serves as a measure for the evolutionary level. p-Adically also extensions determined by roots of  $e$  can be considered. What is so remarkable is that the number theoretic entropy can be negative.

A simple example allows to get an idea about what is involved. If the entanglement probabilities are rational numbers  $P_i = M_i/N$ ,  $\sum_i M_i = N$ , then the primes appearing as factors of  $N$  correspond to a negative contribution to the number theoretic entanglement entropy and thus to information. The factors of  $M_i$  correspond to negative contributions. For maximal entanglement with  $P_i = 1/N$  in this case the entanglement entropy is negative. The interpretation is that the entangled state represents quantally concept or a rule as superposition of its instances defined by the state pairs in the superposition. Identity matrix means that one can choose the state basis in arbitrary manner and the interpretation could be in terms of “enlightened” state of consciousness characterized by “absence of distinctions”. In general case the basis is unique.

Metabolism is a central concept in biology and neuroscience. Usually metabolism is understood as transfer of ordered energy and various chemical metabolites to the system. In TGD metabolism could be basically just a transfer of NE from nutrients to the organism. Living systems would be fighting for NE to stay alive (NMP is merciless!) and stealing of NE would be the fundamental crime.

TGD has been plagued by a longstanding interpretational problem: can one apply the notion of number theoretic entropy in the real context or not. If this is possible at all, under what conditions this is the case? How does one know that the entanglement probabilities are not transcendental as they would be in generic case? There is also a second problem: p-adic Hilbert space is not a well-defined notion since the sum of p-adic probabilities defined as moduli squared for the coefficients of the superposition of orthonormal states can vanish and one obtains zero norm states.

These problems disappear if the reduction occurs in the intersection of reality and p-adicities since here Hilbert spaces have some algebraic number field as coefficient field. By SH the 2-D states states provide all information needed to construct quantum physics. In particular, quantum measurement theory.

1. The Hilbert spaces defining state spaces has as their coefficient field always some algebraic extension of rationals so that number theoretic entropies make sense for all primes. p-Adic numbers as coefficients cannot be used and reals are not allowed. Since the same Hilbert space is shared by real and p-adic sectors, a given state function reduction in the intersection has real and p-adic space-time shadows.
2. State function reductions at these 2- surfaces at the ends of CD take place in the intersection of realities and p-adicities if the parameters characterizing these surfaces are in the algebraic extension considered. It is however not absolutely necessary to assume that the coordinates of WCW belong to the algebraic extension although this looks very natural.

3. Does NMP apply to the sum of real and p-adic entropies (Option 1) or only to the sum of p-adic entanglement entropies (which can be negative) (Option 2). The situation is not settled yet.
  - (a) For Option 1 the total entropy vanishes identically for *rational* probabilities and NMP would say nothing about the situation [L26]. NMP would not prevent or favor state function reduction. It is not clear whether this situation corresponds to that in the physics of ordinary matter as opposite to that of living matter. For algebraic probabilities there would be a competition between real and p-adic sectors and p-adic sectors would win for algebraic extensions in the sense that p-adic entropy would be larger than real entropy.
  - (b) For Option 2 NMP would stabilize NE also for rational probabilities. One can wonder whether one obtains the ordinary state function reduction at all for this option. In ZEO state function reductions to the opposite boundary of CD would be however forced to occur and second law would be the outcome also in this case.

For both options it could quite well happen that NMP for the sum of real and p-adic entanglement entropies does not allow the ordinary state function reduction to take place since p-adic negative entropies for some primes would become zero and net negentropy would be lost.

In both cases mind would have causal power: it can stabilize quantum states against state function reduction and tame the randomness of quantum physics in absence of cognition! Can one interpret this causal power of cognition in terms of intentionality? If so, p-adic physics would be also physics of intentionality as originally assumed.

A fascinating question is whether the p-adic view about cognition could allow to understand the mysterious looking ability of idiot savants (not only of them but also of some greatest mathematicians) to decompose large integers to prime factors. One possible mechanism is that the integer  $N$  represented concretely is mapped to a maximally entangled state with entanglement probabilities  $P_i = 1/N$ , which means NE for the prime factors of  $P_i$  or  $N$ . The factorization would be experienced directly.

One can also ask, whether the other mathematical feats performed by idiot savants could be understood in terms of their ability to directly experience - "see" - the prime composition (adelic decomposition) of integer or even rational. This could for instance allow to "see" if integer is - say 3rd - power of some smaller integer: all prime exponents in it would be multiples of 3. If the person is able to generate an NE for which probabilities  $P_i = M_i/N$  are apart from normalization equal to given integers  $M_i$ ,  $\sum M_i = N$ , then they could be able to "see" the prime compositions for  $M_i$  and  $N$ . For instance, they could "see" whether both  $M_i$  and  $N$  are 3rd powers of some integer and just by going through trials find the integers satisfying this condition.

### 8.3 ZEO and generalization of quantum measurement theory to a theory of consciousness

TGD inspired theory of consciousness can be seen as a generalization of the quantum measurement theory by making observer part of physical system as conscious entity subject to laws of quantum physics. I will talk about this conscious entity as self and pose no a priori restrictions what self can be. The basic vision is that quantum measurement theory must be generalized so that observer ceases to be an outsider and is described by the quantum physics. ZEO plays a key role in this generalization and makes highly non-trivial predictions. Raising quantum measurement to a universal physical phenomenon requires the identification of the density matrix of subsystem as a universal observable and introduction of Negentropy Maximization Principle (NMP) [K52] as the fundamental variational principle of consciousness.

#### 8.3.1 ZEO

One must generalize ontology in order to solve the contradiction between deterministic time evolution and the evolution by state function reductions. This requires understanding the notion of



subjective time and its relationship to the geometric time. The new ontology must allow to see selves as something unchanged in some aspects and continually changing in some other aspects. Also the experience about the flow of subjective time must be explained.

1. In TGD framework the answer is ZEO [K52]. The concept of quantum state is generalized. States are now analogs for physical events characterized by initial and final quantum state that is pairs of positive and negative energy states. The conserved quantum numbers of the members are opposite so that zero energy states can be created from vacuum. This is a radical generalization of the physicalist world of view but entirely consistent with conservation laws: there is no need to give laws of physics in order to have free will. Positive and negative energy parts of the zero energy states can be assigned to opposite light-like boundaries of CDs, which are intersections of future and past directed light-cones multiplied by  $CP_2$ . CDs form a fractal scale hierarchy. They can be seen as embedding space correlates for the 4-D perceptive fields of selves.
2. CD is a central notion in ZEO and serves as embedding space correlate for self. State function reduction can occur to either boundary of CD (“upper” or “lower”). Self can be seen as a generalized Zeno effect - a sequence of state function reductions to either boundary of CD. These two kinds of selves can be said to be time reversals of each other. The period of non-boiling pot corresponds to the passive boundary of CD not changing in the reductions: also the parts of zero energy states at this boundary remain unaffected. The opposite - active - boundary is shifted towards future reduction by reduction and states at it are changed. The shifting the geometric future gives rise to the experienced time flow. This is the analog of unitary time evolution.

### 8.3.2 NMP as variational principle of consciousness

One must generalize standard quantum measurement theory to a theory of consciousness. The notions of NMP, entanglement negentropy and negentropic entanglement (NE) are the key notions.

1. Negentropy Maximization Principle (NMP) [K52] is the variational principle of consciousness in TGD framework reducing to quantum measurement theory in Zero Energy Ontology assuming adelic physics. Negentropy Maximization Principle or something akin to it should be consistent with the standard rules of quantum measurement theory and possibly generalize them. In particular, NMP should tell which observables are measured in given entangled situation. The density matrix defined by the entanglement is the unique candidate for the universal observable. All systems could be said to give rise to quantum measurements. NMP must decide how long the self “lives”: self lives as long as repeated state function reductions at the same boundary give the maximal negentropy gain.
2. One must have a mathematical definition of negentropy [K52]. When NE is possible and what is the measure for the negentropy? Shannon entropy is the natural starting point but it cannot have negative values in real context. One could define information as a reduction of entropy as conscious observer learns the state of the system under consideration: the IIT approach of Tononi [J70], [L32, K55] relies on this notion and leads to a circular definition of conscious information. Now however the conscious entity would be this system and this definition of information does not apply. One must find a genuine measure of information assignable to entanglement as entanglement negentropy rather than lack of information about the state of either entangled member of entangled by identifiable as entanglement entropy (ordinary Shannon entropy).

Here one cannot avoid number theory and I can only apologize. The p-adic generalization of Shannon entropy by replacing the logarithms of probabilities with the logarithms of their p-adic norms provides a possible solution of the problem [K52, K6]. It is well defined for algebraic entanglement probabilities belonging to the algebraic extension of rationals defining also the extensions of various various p-adic number fields) [L26].

Adelicity (roughly: adeles correspond to Cartesian product of positive real numbers and all p-adic number fields) holds true in the sense that the sum of real and p-adic information

measures (finite number of primes contribute) over all primes vanishes for rational entanglement probabilities. This is not the case for the algebraic extensions of adeles induced by those of rationals [L26].

It is not quite clear whether NMP applies to the sum of p-adic entropies or to the sum of real and p-adic entropies providing alternative definitions of information. Both options conform with the fact that large entropy seems to be prerequisite for life as proposed Jeremy England [I35] [K66] [L20].

3. NE (negentropic entanglement) is a further key notion and entanglement negentropy identified as number theoretic entanglement entropy, which can be negative. NE can only increase in state function reductions and this brings in evolution forced by NMP.

In the formulation of NMP in terms of maximal negentropy gain one considers divisions of the system into subsystem and complement and finds the pair for which the reduction of entanglement would give maximum reduction of entropy. If the system is irreducible this kind of pair characterized by entropic entanglement cannot be found. The eigenstates of density matrix for negentropically entangled subsystems are in 1-1 correspondence. An interesting question is whether associations in the sense of neuro science corresponds to NE between the states of associated systems.

State function reduction cascade is a key notion. State function reduction sequences is a top down cascade propagating downwards to smaller system sized. First the reduction in CD scale occurs. The resulting two subsystems decompose to two parts and so on until decomposition is not possible anymore because it would not generate negentropy.

There is an obvious analogy with the Integrated Information Theory (IIT) of Tononi and Koch. The quantity  $\Phi$  postulated by Tononi and Koch [J70] resembles negentropy in TGD [L32]. The basic objection against IIT is that the notion of conscious information is circular being based on entropy as fundamental notion. Information is defined as reduction of entropy when conscious entity learns what the state of system is. The notion of conscious information cannot involve this kind of dependence. The outcome is a paradox: printer printer text is conscious if no-one knows about the contents of the file, not if some-one already knows since the definition of conscious information reduces it to conscious information gained by the outsider. This is not surprising, since entropy as a notion belongs to the physics of outsider about object rather than subject.

In TGD framework negentropy for entanglement does not involve this kind of assumption since conscious information represents abstraction or rule with the superposed state pairs  $(a_i, b_i)$  representing the instances of a rule  $(A, B)$  and  $A$  and  $B$  representing concepts.

### 8.3.3 Details related to NMP

What happens in state function reduction and what NMP really says is still far from being completely clear. The basic condition is that standard measurement theory emerges as a special case and is forced by NMP [K52]. This does not however fix the NMP completely.

#### 1. *Adelic NMP as the only reasonable option*

I have considered two options for NMP.

1. In the original approach to NMP it was assumed that both generic entanglement with real entanglement probabilities and entanglement with algebraic entanglement probabilities are possible. Real entanglement is entropic and demands standard measurement theory leading to a 1-D eigen-space of the density matrix. Algebraic entanglement can be negentropic in number theoretic sense for some p-adic primes, and in this case state function reduction occurs only if it increases negentropy. It takes place to N-dimensional eigen-space of the density matrix. The basic objection is that real entanglement is transcendental in the generic case reducing to algebraic entanglement only as a special case. Algebraic entanglement is also extremely rare without additional physical assumptions.
2. In the adelic approach entanglement coefficients and therefore also entanglement probabilities are always algebraic numbers from the condition that the notion of p-adic Hilbert space makes sense. Also extensions of rationals defining finite-dimensional extension of p-adic numbers

(roots of  $e$  can appear in extension) must be allowed. Same entanglement can be seen from both real (sensory) and p-adic perspectives (cognitive). The entanglement is always entropic in the real sector but can be negentropic in some p-adic sectors. It is now clear that the adelic option is the only sensible one.

2. *Variants of the adelic NMP*

The adelic option allows to consider several variants.

1. Negentropy could correspond **a)** to the sum  $N = N_R + \sum_p N_p$  of real and various p-adic negentropies or **b)** to the sum  $N = \sum_p N_p$  of only p-adic negentropies.  $N_p$  is non-vanishing for a finite number of p-adic primes only as is easy to find. In both cases  $\sum_p N_p$  could be interpreted as negentropy assignable to cognition.  $N_R$  might have interpretation as a measure of ignorance of one of the entangled systems about the state of other.
2. NMP implies that state function reduction (measurement of density matrix leading to its eigen-space) occurs if negentropy **1)** is not reduced or **2)** increases. This means that NE is stable against NMP.

Can one select between these options?

1. For option **a)** NMP becomes trivial for rational entanglement probabilities as is easy to find: one has  $N = N_R + \sum_p N_p = 0$ . NMP does not force state function reduction to occur but it could occur and imply ordinary state function reduction as a special case for option **1)** (when eigen-spaces are 1-dimensional). Therefore one would have option **1a)**.
2. If option **1a)** is unrealistic, only the options **1b)** and **2b)** with  $N = \sum_p N_p$  are left. For option **2b)** state function necessarily occurs for  $N = \sum_p N_p < 0$  but not for  $N = 0$  - not even in rational case. For option **2b)** the state function reduction could occur also for  $N = 0$ . However, since  $N_p$  is proportional to  $\log(p)$  and the numbers  $\log(p)$  are algebraically independent,  $N = 0$  is not actually possible so that **1b)** and **2b)** are equivalent. Therefore NMP states that  $N = \sum_p N_p$  must increase for  $N < 0$ : this forces state function reduction to an eigen-space of density matrix.

But is it really possible to have  $\sum_p N_p < 0$  making possible ordinary state function reduction? For rational entanglement probabilities this is not possible by  $S_R = \sum_p N_p$  and one might even speculate that for algebraic extensions one as  $\sum_p N_p \geq S_R$ . Mathematician could probably check the situation.  $\sum_p N_p \geq S_R$  holds true, entanglement is stable against NMP and ordinary state function reduction is not possible. This would leave only the option **1a)** and NE with  $N > 0$  would be stable also now.  $N = 0$  entanglement (possibly rational always) would allow ordinary state function reduction.

This leaves still two options. Negentropy gain is **A)** maximal or **B)** non-negative but not necessarily maximal: I have considered the latter option earlier. For option **1a)** reduction is possible only for  $N = 0$  and in this case negentropy gain is zero for all possible eigen-spaces of density matrix and maximality condition does not say anything.

1. For option **1a)** reduction is possible only for  $N = 0$  and in this case negentropy gain is zero for all possible eigen-spaces of density matrix and **A)** and **B)** are equivalent. One obtains ordinary state function reductions.
2. Consider next the equivalent options **1b)** and **2b)** making sense if  $\sum_p N_p < 0$  is possible. For option **A)** negentropy gain is maximal and the reduction occurs to an eigen-space with maximum dimension  $N = N_{max}$ . There can be several eigen-spaces with the same maximal dimension. As a special case one obtains ordinary state function reduction. The reduction probability is same as in standard quantum measurement theory.

For option **B)** the reduction could occur also to any  $N$ -dimensional eigen-space or its sub-space. The idea would be that NMP allows something analogous to a choice between good and evil: the negentropy gain could in this case be also smaller than the maximal one corresponding to  $\log(N_{max})$ . This would conform with the intuition that we do not seem to

live in best possible world. On the other hand, negentropy transfer between systems could be also seen as stealing in some situations and metabolism identified as negentropy transfer could be seen as the fundamental “crime” to which all other forms of reduce.

To sum up, the only option which guarantees without additional assumptions (possibility of  $\sum N_p < 0$ ) ordinary state function reduction and stability of NE is option **1a**).

3. *Could quantum measurement involve also adelic localization?*

For option **B**) there is still one possible refinement involved. p-Adic mass calculations lead to the conclusion that elementary particles are characterized by p-adic primes and that p-adic length scale hypothesis  $p \simeq 2^k$  holds true: a more general form of hypothesis allows also to consider primes near powers  $q^n$  of some small prime such as  $q = 3$ .

Could state function reduction imply also adelic/cognitive localization in the sense that the negentropy is nonzero and positive for only single p-adic prime in the final state? The reduction would occur to  $p^k$ -dimensional eigen-space with  $p^k$  dividing  $N$ : any divisor would be allowed. Note that Hilbert spaces with prime dimension are prime with respect to the decomposition to tensor product so that reduction would select prime power factor of the eigen-space. This would in general reduce negentropy gain.

The information theoretic meaning would be that prime-dimensional Hilbert spaces are stable against decomposition to tensor products so that the notion of entanglement would not make sense and therefore also the change of the state by the reduction of entanglement would be impossible. I have considered the possibility that prime-dimensional state spaces could make possible stable storage of quantum information [L33]. The prime-dimensional state when imbedded to higher-dimensional space - say space representing  $N$  qubits - could be interpreted as an entangled state and would be unstable with respect to state function reduction.

This hypothesis would provide considerable insights to the origin of p-adic length scale hypothesis. To get a contact with physics consider electron as an example.

1. In the case of electron one would have  $p = M_{127} = 2^{127} - 1 \sim 10^{38}$ . Could electron decompose to two entangled subsystems with density matrix equal to  $p \times p$  identity matrix? The dimension of eigen-space would be huge and electron would carry negentropy of 127 bits: also p-adic mass calculations combined with a generalization of Hawking-Bekenstein formula suggest that electron carries entropy of 127 bits: in adelic picture these views are mutually consistent.

The recent view indeed is that all elementary particles correspond to closed monopole magnetic flux tubes with a shape of highly flattened rectangles with short sides identifiable as extremely short wormhole contacts ( $CP_2$  size) and long sides with length of order Compton length. Magnetic monopole flux traverses along first space-time sheet between wormhole throats, goes through wormhole contact, and returns back along second space-time sheet. Many-fermion states are assigned with the throats and are located at the ends of strings traversing along the flux tubes.

Could this structure be in the case of electron a 127-sheeted structure such that the two wormhole contacts carry a superposition of pairs formed by states containing  $n \in \{1, \dots, 127\}$  fermions at second contact and  $n$  antifermions with opposite charges at second contact so that  $2^{127} - 1$  dimensional eigen-space would be obtained for a fermion with given spin and isospin. For instance,  $n = 0$  state with no fermion-pairs could be excluded.

2. Right-handed neutrinos and antineutrinos are candidates for the generators of  $N = 2$  supersymmetry in TGD framework. It however seems that SUSY is not manifested at LHC energies, and one can wonder whether right-handed neutrinos might be realized in some other manner. Also the mathematics involved remains still somewhat unclear. For right-handed neutrinos, which are not covariantly constant transformation to left-handed neutrinos is possible and leads to the mixing and massivation of neutrinos. For covariantly constant right handed neutrino spinors this does not happen but they can included into the spectrum only if they have non-vanishing norm.

This might be the case with a proper definition of norm with  $\bar{\Psi} p^k \gamma_k \Psi$  replaced by  $\bar{\Psi} n^k \gamma_k \Psi$ : here  $n^k$  defines normal of the light-like boundary of CD. Covariantly constant right-handed

neutrinos have neither electro-weak, color, nor gravitational interactions so that their NE would be highly stable. Unfortunately, the situation is still unclear and this leaves open the idea that right-handed neutrinos might play fundamental role in cognition and negentropy storage. Amusingly, I proposed the notion of cognitive neutrino long time ago but based on arguments which turned out to be wrong.

One could indeed consider the possibility that each sheet of the 127-sheeted structure contains at most one  $\nu_R$  at the neutrino end of the flux tube accompanied by  $\bar{\nu}_R$  at anti-neutrino end. One would have a superposition  $p = 2^{127} - 1$  states formed by many-neutrino states and their CP conjugates at opposite “ends” of the flux tube. It is also possible that  $\bar{\nu}_R - \nu_R$  pairs are spin singlets so that one has superposition over many-particle states formed from these analogous to coherent state.

This is not the only possibility. The proposal for how the finite range of weak interactions emerges suggests a possible realization for how the number of states in superposition reduces from  $2^{127}$  to  $2^{127} - 1$ . The left weak isospin of fermion at wormhole throat is compensated by the opposite weak isospin of neutrino/antineutrino plus  $\bar{\nu}_R/\nu_R$  or cancelling its fermion number: therefore weak charges vanish in scales longer than the flux tube length of order of the Compton length. The physical picture is that massless weak boson exchanges occur inside the flux tube which therefore defines the range of weak interactions. Same mechanism could be at work for both wormhole throat pairs and therefore also for fermion and anti-fermion at opposite wormhole throats defining building bricks of bosons. The state  $\bar{\nu}_R - \nu_R$  would be excluded from the superposition of pairs of many-particle states and superposition would contain  $p = 2^{127} - 1$  states.

3. Could this relate to  $h_{eff} = n \times h$  hypothesis? It has been assumed that  $h_{eff}/h = n$  corresponds to space-time surfaces representable as  $n$ -fold singular coverings, whose sheets co-incide at the 3-D ends of the space-time surface at opposite boundaries of CD. There is of course no need to assume that the covering considered above corresponds to singular covering and the vision that only particles with same value of  $n$  appear in same vertices suggests that  $n = 1$  holds true for visible matter.

One can still ask whether the elementary particle characterized by  $p \simeq 2^k$  could corresponds to  $k$ -fold singular covering and to  $h_{eff}/h = k$ ? This would require that phase transitions changing the value of  $k$  take place at the lines of scattering diagrams to guarantee that all particles have the same value of  $k$  in given vertex. These phase transitions are a key element of TGD inspired quantum biology.

In the first order of perturbation theory this would not mean any deviations from standard quantum theory for given  $k$  and the general vision that loop corrections from the functional integration over WCW vanish suggests that there are no effects in perturbation theory for given  $k$ . p-Adic coupling constant evolution would be discrete and make itself visible by the phase transitions at the lines of scattering diagrams (not identifiable as Feynman diagrams). The different values of  $h_{eff}/h = n$  be also seen through non-perturbative effects assignable to the bound states and also via the proportionality of p-adic mass scales to  $p^{-1/2} \simeq 2^{-k/2}$  predicted by p-adic mass calculations.

### 8.3.4 The notion of self

Self is identified as a generalized Zeno effect and corresponds to a sequence of state function reductions to a fixed (passive) boundary of CD remaining unaffected in the sequence of reductions: also the members of state pairs defining zero energy states at it are unaffected. Active boundary drifts farther away state function reduction by state function reduction and the state at it also changes. The analogy of unitary time evolution is in question and the experienced time corresponds to the increase of the temporal distance between the tips of CD.

1. One possibility is that sensory input and mental images (“Maya”) generated by it can be assigned with the active boundary of CD. A more elegant assumption suggested by quantum measurement theory is that the passive boundaries for sub-CDs give rise to mental images as outcomes of repeated quantum measurements. The unchanging part of self (“Self”) is

associated with the passive boundary. It corresponds to negentropically entangled subsystem having no entanglement with environment. In ordinary ontology it would not be possible keep self un-entangled from the environment.

2. State function reductions occur at either boundary of CD as long as they produce maximal negentropy gain. If the reduction at opposite boundary produces larger negentropy gain, it occurs. Self dies and re-incarnates as time reversed self. During repeated state function reductions at same boundary the part of state at that boundary and boundary itself remains unaffected (this corresponds to unchanging part of self) whereas the state at opposite boundary changes and the boundary also shifts outwards. The increase of the distance between the tips of CD corresponds to the flow of geometric time and gives precise meaning for the ageing of self. For instance, sensory-motor rhythm could correspond to the sequence of repeated state function reductions to opposite boundaries of CD. Motor action would correspond to reversed arrow of time: this conforms with the finding of Libet that conscious decision is preceded by neural activity used to argue that there is no free will.

Time reversed self evolves as reductions shifting the opposite boundary of CD to opposite time direction so that the size of CD continues to increase and defines a measure for the duration of the entire sequence of re-incarnations. This implies quantum physical realization for the idea about transmigration of souls!

3. Repeated state function reductions form a sequence for analogs of unitary time evolutions lasting time  $\Delta t$ , which corresponds to the increase of the temporal distance between tips of initial and final CD. Ordinary Hamiltonian clock time evolution does not make sense except as idealization. Is  $\Delta t$  constant or is it determined by the reduction statistically? The most general and the only non adhoc assumption is that a superposition of CDs with different values of  $\Delta t > 0$  is formed and that each repeated state function reductions perform a position measurement - that is localization of the active boundary of CD - so that one  $\Delta t$  is selected and  $\Delta t$  is thus varying. One can speak about average  $\Delta$  as a kind of chronon of clock-time.
4. Suppose that self dies and thus re-incarnates as time reversed self  $S_1$ , and  $S_1$  in turn dies and reincarnates as  $S_2$  having the same arrow of time as  $S$ . Does  $S_2$  re-incarnate at the time when  $S$  died? This does not make sense. Also the first reduction to opposite boundary of CD must involve non-vanishing  $\Delta t$ . This conforms with what is known about claimed re-incarnations and might allow to test re-incarnation hypothesis.
5. The totally unexpected prediction is therefore that life is not just a brief spark in cosmic darkness. This particular life is only one in a sequence of lives: the next life will be lived at the opposite boundary of personal CD to opposite direction of geometric time. The negentropy gained during his life will be usable as possibly unconscious knowledge during the next life. What our next life will be depends how much we gather negentropic resources for the next life.
6. Self can also make moral choices since NMP in its weak form leaves us freedom to make also bad choices or especially negentropic choices (for details see [K52]). Possible are also choices, which do not yield optimal negentropy gain. By allowing sin NMP also makes possible really big negentropy gains: NMP would be like venture capitalist in this sense. In statistical sense there is however an evolution as increase of the negentropic sources of the Universe. Crime is part of being alive: living creatures are fighting desperately for NE and a clever but immoral manner to gain it is to eat other living beings.
7. One big news is that selves form a hierarchy (CDs within CDs) and sub-selves are identified as mental images. In TGD framework it is also possible for sub-selves of two unentangled selves to entangle negentropically. This corresponds to sharing of mental images and means that our conscious experience is not completely private. The pool of shared mental images might in fact make possible communication and social structures. Sharing of mental images is possible only in many-sheeted space-time forcing to generalize the standard view about subsystem.

## 8.4 Some applications

The ontology behind the applications involves the notion of many-sheeted space-time, ZEO, hierarchy of Planck constants identified in terms of dark matter, and p-adic physics as physics of cognition. Also magnetic body (MB) carrying dark matter and energy having non-standard value of Planck constant  $h_{eff} = n \times h$  identified as intentional agent represents new ontology. The additional assumption  $h_{eff} = h_{gr}$  identifying  $h_{eff}$  with gravitational Planck constant is rather powerful. Also p-adic length scale hypothesis is also central in applications.

### 8.4.1 The notion of magnetic body (MB)

MB is assumed to be carrier of dark matter.

1. The flux tubes of MB can suffer  $h_{eff}$  changing phase transitions inducing the change of the length of flux tube. This leads to a view about living matter as a network of bio-molecules connected by magnetic flux tubes. The ability of biomolecules to find each other in the dense molecular soup would rely on the reduction of  $h_{eff}$  bringing molecules near each other. The reconnections of flux tubes possible if the field strengths are same and therefore also cyclotron frequencies are identical are also expected to central element in bio-communications since they change the topology of the network and make possible analogs of relays.

The receptors to which information molecules attach could be seen as plugs to which magnetic flux tubes having information molecule at its end attach and give rise to a fusion of two flux tubes to a longer flux tube connection. For instance, nerve pulse transmission would be more like building quantum connections than communication.

2. Flux tubes with large  $h_{eff}$  make possible high  $T_c$  superconductivity [K71, K72]. Superconducting structures would be pairs of flux tubes carrying magnetic fluxes which have same or opposite directions. Cooper pairs would have members at separate flux tubes.

#### MB as intentional agent

Magnetic field associated with a given system decomposes to flux tubes and sheets to that system has MB (MB). The physics of MBs could be a new chapter in physics and MB could define the basic space-time correlate for non-locality.

1. Flux tubes of MB would serve as correlates for quantum entanglement, which in TGD framework can be negentropic and for this reason rather stable under state function reductions. In GRT context the idea about wormholes as correlates of entanglement between blackholes is highly analogous. The problem with wormholes is that they are highly unstable. Magnetic flux tubes carrying monopole flux are stable since flux conservation prevents their pinching. The pairs of flux tubes with opposite fluxes can however split to two U-shaped flux tubes by reconnection. It is important to notice that magnetic flux tubes are necessarily closed and can be regarded as flux running along different space-time sheets in opposite direction and from sheet to another through the wormhole contacts at ends.

One can of course ask whether the braiding of flux tubes could be the correlate for entanglement. To my opinion entanglement without braiding is possible.

2. MB and dark matter at it would serve as intentional agent in biological systems [?]. The organism-environment duality would be replaced by the trinity MB-organism-environment. For instance, EEG and its strong correlation with brain state and consciousness could be understood in terms of communication of sensory data from cell membranes to MB and control and coordination signals from MB to biological body [K29]. Signals would consist of dark photons with energies  $E = h_{eff}f = n \times hf$  in bio-photon energy range and thus above thermal energies. For instance, the recently observed synchrony between hemispheres in absence of corpus callosum [J46] could be understood in terms of MB serving as “boss”.
3. The formation of flux tube reconnections would serve as a correlate for directed attention - attention could be directed to objects of external world or to their representations in brain.

The reconnection would take place for U-shaped flux tubes serving as kind of magnetic tentacles and lead to a formation of pairs of flux tubes connecting the two systems. If flux tubes carry monopole flux as one has reasons to expect, the flux tubes would be actually closed two-sheeted structures (also elementary particles would be this kind of structures) and flux tube pair would be pair of these. The flux tubes of MBs would serve as analogs of wave guides along with precisely targeted communications of dark photon signals (“massless extremals” (MEs)) would be possible. Also supra currents would be possible and the TGD based model of high  $T_c$  superconductivity relies on the same mechanism [K71]. These communications would be essential in living matter.

4. The formation of reconnections and phases transitions  $n \rightarrow m$  changing  $h_{eff} = n \times h$  would be a basic mechanism behind biocochemistry. U-shaped flux tubes would act like tentacles emerging from the system and reconnection of the tentacles would build a connection between two systems. The reduction of Planck constant would shorten the connecting flux tubes and could force the systems in the vicinity of each other after which bio-catalysis could take place. Braiding and its 2-braid variant for string world sheets and partonic 2-surfaces in 4-D space-time instead of strings in 3-D space would make possible realization of quantum computer program like structures.

### MB is 4-dimensional

MB as preferred extremal represents in terms of space-time topology and geometry 4-D self-organization patterns, behaviors, functions, and skills. What is new that self-organization occurs for 4-D patterns rather than 3-D ones. The entire process is replaced with a new one. Sequence of state function reductions leads from a 4-D self-organization pattern to an asymptotic 4-D self-organization pattern [K70].

Morphogenesis provides examples of this kind of phenomena [I29, I30, I43]. The first key idea is that DNA and cell replication is induced by the replication of MBs serving as information carriers (see <http://tinyurl.com/ydg6okkk>) [K70]. The second key idea is that in zero energy ontology (ZEO) MB is 4-dimensional and represents behavioral patterns rather than only 3-dimensional patterns.

According to Michael Levin, concerning morphogenesis and morphostasis the basic challenge is to understand how the shape of the organism is generated and how it is preserved. The standard local approach based on belief on genetic determinism does not allow one to answer these questions satisfactorily.

1. The first approach to this problem relies on a self-organization paradigm in which the local dynamics of cells leads to large scale structures as self-organization patterns. In TGD framework 3-D self-organization is replaced with 4-D self-organization (the failure of strict determinism of the classical dynamics is essential motivating zero energy ontology (ZEO)). One can speak about 4-D healing: expressing it in somewhat sloppy manner, the space-time surface serving as a classical correlate for the patient is as a whole replaced with the healed one: after the 4-D healing process the organism was never ill in geometrical sense! Note that in quantal formulation one must speak of quantum superposition of space-time surfaces.
2. Second approach could be seen as computational. The basic idea is that the process is guided by a template of the target state and morphogenesis and healing are computational processes. What Levin calls morphogenetic fields would define this template. It is known that organisms display a kind of coordinate grid providing positional information that allows cells to “decide” about the profile of genetic expression (for references see [I30]). In TGD framework MB forming coordinate grid formed from flux tubes is a natural candidate for this structure. They would also realize topological quantum computation (TQC) with basic computational operations realized at the nodes of flux tubes to which it is natural to associate some biological sub-structures.

The assumption about final goal defining a template can be argued to be too strong: much weaker principle defining a local direction of dynamics and leading automatically to the final state as something analogous to free energy minimum in thermodynamics might be enough. Unfortunately,



second law is the only principle that standard physics can offer. Negentropy Maximization Principle (NMP) provides the desired principle in TGD framework. Also the approach of WCW spinor field to the maximum of vacuum functional (or equivalently that of Kähler function) gives a goal for the dynamics after the perturbation of the organism causing "trauma". If Kähler function is classical space-time correlate for entanglement negentropy, these two views are equivalent.

TGD thus suggests an approach, which could be seen as a hybrid of approaches based on self-organization and computationalism. The MB becomes the key notion and codes also for learned behaviors as TQC programs coded by the braiding of flux tubes. The replication of the MB means also the replication of the programs behind behavioral patterns (often somewhat misleadingly regarded as synonymous with long term memories): both structure and function are replicated. This hypothesis survives the killer tests provided by the strange findings about planaria cut into two and developing new head or tail while retaining its learned behaviors: the findings indicate that behavioral programs are preserved although planaria develops a new brain.

#### $h_{gr} = h_{eff}$ hypothesis

Nottale [E1] introduced originally the notion of gravitational Planck constant  $\hbar_{gr} = GMm/v_0$ , where  $M$  is large mass such as that of Earth or Sun and  $m$  the mass of quantum coherent object and  $v_0$  is a parameter with dimensions of velocity [E1]. Nottale did not propose macroscopic quantum coherence in astrophysical scales but in TGD framework this is a natural option [K87, K64].

The obvious question is whether the gravitational Planck constant deduced from the Nottale's considerations and the effective Planck constant  $h_{eff} = n \times h$  deduced from ELF effects on vertebrate brain and explained in terms of non-determinism of Kähler action could be identical. At first this seems to be non-sensical idea since  $\hbar_{gr} = GMm/v_0$  has a gigantic value. The hypothesis  $h_{eff} = \hbar_{gr}$  leads to much stronger predictions [K66, ?] than either hypothesis alone. One can also introduce analogs of  $h_{gr}$  for other interactions: the idea is that when the coupling strength between two charges becomes so large that perturbation theory does not exist, a phase transition increasing the Planck constant happens and guarantees the convergence.

The essential point is that  $h_{eff}$  and  $h_{gr}$  would characterized body parts of MB: this allows to understand the dependent on masses of two particles. The flux tubes with a given value of  $h_{eff}$  would carry only particles of particular mass  $m$  so that the random soup of biomolecules would become a highly ordered structure analogous to library in which each book type is its own shelf. Furthermore, the cyclotron energies  $E_c \propto h_{eff}/m$  would be same irrespective of particle mass  $m$  although cyclotron frequencies are different.

The proposed identification of the energy range of dark photon cyclotron energies in living matter is as visible and UV range assigned to bio-photons which would therefore result in the transformation of dark photons to ordinary photons. Further important point, is that the energy spectrum would be in the range of molecular excitation energies (visible and UV range) so that dark photons transformed to ordinary ones would allow MBs to control biochemistry.

By Equivalence Principle one can describe gravitational interaction by reducing it to elementary particle level. For instance, gravitational Compton lengths do not depend at all on the masses of particles. Also the radii of the planetary orbits are independent of the mass of particle mass in accordance with Equivalence Principle. For elementary particles the values of  $h_{gr}$  are in the same range as in quantum biological applications. Typically 10 Hz ELF radiation should correspond to energy  $E = h_{eff}f$  of UV photon if one assumes that dark ELF photons have energies of biophotons and transform to them. The order of magnitude for  $n$  would be therefore  $n \simeq 10^{14}$ .

The experiments of M. Tajmar *et al* [E6, E11] discussed in [K91] provide a support for this picture. The value of gravimagnetic field needed to explain the findings is 28 orders of magnitude higher than theoretical value if one extrapolates the model of Meissner effect to gravimagnetic context. The amazing finding is that if one replaces Planck constant in the formula of gravimagnetic field with  $h_{gr}$  associated with Earth-Cooper pair system and assumes that the velocity parameter  $v_0$  appearing in it corresponds to the Earth's rotation velocity around its axis, one obtains correct order of magnitude for the effect requiring  $r \simeq 3.6 \times 10^{14}$ .

The most important implications are in quantum biology and Penrose's vision about importance of quantum gravitation in biology might be correct.

1. This result allows by Equivalence Principle the identification  $h_{gr} = h_{eff}$  at elementary particle level at least so that the two views about hierarchy of Planck constants would be

equivalent. If the identification holds true for larger units it requires that space-time sheet identifiable as quantum correlates for physical systems are macroscopically quantum coherent and gravitation causes this. If the values of Planck constant are really additive, the number of parallel space-time sheets corresponding to non-determinism evolution for the flux tube connecting systems with masses  $M$  and  $m$  is proportional to the masses  $M$  and  $m$  using Planck mass as unit. Information theoretic interpretation is suggestive since hierarchy of Planck constants is assumed to relate to negentropic entanglement very closely in turn providing physical correlate for the notions of rule and concept.

2. That gravity would be fundamental for macroscopic quantum coherence would not be surprising since by EP all particles experience same acceleration in constant gravitational field, which therefore has tendency to create coherence unlike other basic interactions. This in principle allows to consider hierarchy in which the integers  $h_{gr,i}$  are additive but give rise to the same universal dark Compton length.
3. An interesting question is how large systems can behave as coherent units with  $\hbar_{gr} = GMm/v_0$ . In living matter one might consider the possibility that entire organism might be this kind of system. Interestingly, for larger masses the gravitational quantum coherence would be easier. For particle with mass  $m$   $h_{gr}/h > 1$  requires larger mass to satisfy  $M > M_P^2/m_e$ . The first guess that life has evolved from long to shorter scales and reached elementary particle last. Planck mass is the critical mass corresponds to the mass of water blob with volume of size scale of  $10^{-4}$  m (big neuron) is the limit.

The general proposal discussed above is testable. In particular, a detailed study of molecular energies with those associated with resonances of EEG could be highly rewarding and reveal the speculated spectroscopy of consciousness.

### 8.4.2 MB and biology

MB could play a key role in biology as intentional agent using biological body as motor instrument. MB could even serve as a template for biomolecules and even that fundamental bio-chemical processes are induced by those for MB. Dark cyclotron photons transformed to ordinary photons would be the fundamental control tool of MB. Also reconnection of flux tubes, change of length of flux tubes induced by the change of the value of  $h_{eff} = h_{gr}$ , superconductivity associated with a pair of flux tubes could be fundamental control mechanisms.

### MB, biophotons, and biochemistry

The model for quantum biology relying on the notions of MB and dark matter as hierarchy of phases with  $h_{eff} = nh$ , and biophotons [K18, K10] identified as decay products of dark photons. The assumption  $h_{gr} \propto m$  becomes highly predictable since cyclotron frequencies would be independent of the mass of the ion.

1. If dark photons with cyclotron frequencies decay to biophotons, one can conclude that biophoton spectrum reflects the spectrum of endogenous magnetic field strengths. In the model of EEG [K29] it has been indeed assumed that this kind spectrum is there: the inspiration came from music metaphors suggesting that musical scales are realized in terms of values of magnetic field strength. The new quantum physics associated with gravitation would also become key part of quantum biophysics in TGD Universe.
2. For the proposed value of  $h_{gr}$  1 Hz cyclotron frequency associated to DNA sequences would correspond to ordinary photon frequency  $f = 3.6 \times 10^{14}$  Hz and energy 1.2 eV just at the lower limit of visible frequencies. For 10 Hz alpha band the energy would be 12 eV in UV. This plus the fact that molecular energies are in eV range suggests very simple realization of biochemical control by MB. Each ion has its own cyclotron frequency but same energy for the corresponding biophoton.
3. Biophoton with a given energy would activate transitions in specific bio-molecules or atoms: ionization energies for atoms except hydrogen have lower bound about 5 eV (<http://tinyurl>).

com/233vcad ). The energies of molecular bonds are in the range 2-10 eV (<http://tinyurl.com/bfsy4ft> ). If one replaces  $v_0$  with  $2v_0$  in the estimate, DNA corresponds to .62 eV photon with energy of order metabolic energy currency and alpha band corresponds to 6 eV energy in the molecular region and also in the region of ionization energies.

Each ion at its specific magnetic flux tubes with characteristic palette of magnetic field strengths would resonantly excite some set of biomolecules. This conforms with the earlier vision about dark photon frequencies as passwords.

It could be also that biologically important ions take care of their ionization self. This would be achieved if the magnetic field strength associated with their flux tubes is such that dark cyclotron energy equals to ionization energy. EEG bands labelled by magnetic field strengths could reflect ionization energies for these ions.

It must be made clear that TGD has had an interpretational problem related to the identification of biophotons as decay product of dark protons [?, K66]. The resolution of this problem leads to conclusion that both Earth's and galactic MBs control living matter with EEG related by scaling. This would be rather dramatic realization of non-locality.

The problem is following. If one wants bio-photon spectrum to be in visible-UV range assuming that bio-photons correspond to cyclotron photons, one must reduce the value of  $r = h_{gr} B_{end} / m v_0$  for Earth particle system by a factor of order  $k = 2 \times 10^{-4}$ .  $r$  does not depend on the mass of the charged particle. One can replace  $B_{end}$  with some other magnetic field having value which is considerably smaller. One can also increase the value of  $v_0$ .

1. For  $h_{gr}$  determined by Earth's mass and  $v_0 = v_{rot}$ , where  $v_{rot} \simeq 1.55 \times 10^{-6} c$  is the rotation velocity of Earth around its axis and for  $B_{end} \rightarrow B_{gal} = 1$  nT, where  $B_{gal}$  is typical strength of galactic magnetic field, the energy of dark cyclotron energy is 45 eV (UV extends to 124 eV). This is roughly by a factor 50 higher than the lower bound for the range of bio-photon energies. One possibility is that  $B_{gal}$  defines the upper limit of the dark photon energies and has variation range of at least 7 octaves with lower limit roughly 1/50 nT.

One can also consider the possibility  $B_{gal}$  defines lower bound for the magnetic field strengths involved and one has  $v_0 > v_{rot}$ . For sun the rotation velocity at Equator is  $v_{rot} = 2 \times 10^{-5}$  m/s and  $v_0$  is  $v_0 \simeq 5.8 \times 10^{-4} c$ . One has  $v_0 / v_{rot} \simeq 29.0$ . If same is true in case of Earth, the value of the energy comes down from 25 eV to 1.6 eV which corresponds to visible wave length.

The assignment of  $B_{gal}$  to gravitational flux tubes is very natural. Now however the frequencies of dark variants of bio-photons would not be in EEG range: 10 Hz frequency would correspond to  $5 \times 10^{-4}$  Hz with period of 42 min. The time scale of 42 min is however very natural concerning consciousness and could be involved with longer bio-rhythms. Scaled EEG spectrum with alpha band around 46 min naturally assignable to diurnal sub-rhythms could be a testable prediction. Natural time would be sidereal (galactic) time with slightly different length of day and this allows a clear test. Recall the mysterious looking finding of Spottiswoode that precognition seems to be enhanced at certain time of sidereal day [J59]. Cyclotron frequency 1 Hz would correspond to 7 hours. One can ask whether 12 hours (25) is the natural counterpart for the cyclotron frequency 1 Hz assignable to DNA. This would correspond to lower bound  $B_{gal} \rightarrow 7B_{gal}/12 \simeq .58$  nT or to  $v_0 \rightarrow 1.7v_0$ .

2. The idea has been that it is dark EEG photons, which correspond to bio-photons. Could one assign bio-photons also to dark EEG so that magnetic fields of Earth and galaxy would correspond to two different control levels? If  $B_{end} = .2$  Gauss is assumed to determine the scale of the magnetic field associated with the flux tubes carrying gravitational flux tubes, one must reduce  $h_{gr}$ . The reduction could be due to  $M \rightarrow M_D = kM$  and due to the change of  $v_0$ .  $k$  could characterize the dark matter portion of Earth but this assumption is not necessary.

This would require  $k = M_{dark,E} / M_E \simeq 5 \times 10^{-5}$  if one does not change the value of  $v_0$ . This value of  $k$  equals to the ratio of  $B_{gal} / B_{end}$  and would be 1/4.th of  $k = 2 \times 10^{-4}$ . One might argue that it is indeed dark matter to which the gravitational flux tubes with large value of Planck constant connect biomatter.

- Suppose that one does not give up the idea that also Earth mass gives rise to  $h_{gr}$  and scaled analog of EEG. Then  $M_D$  must correspond to some mass distinguishable from and thus outside Earth. The simplest hypothesis is that a spherical layer around Earth is in question. TGD based model for spherical objects indeed predict layered structures [K104]. There are two separate anomalies in the solar system supporting the existence of a spherical layer consisting of dark mass and with radius equal to the distance of Moon from Earth equal to 60.3 Earth radii [K87]. The first anomaly is so called Flyby anomaly and second one involves a periodic variation of both the value of the measured Newton's constant at the surface of Earth and of the length of the day. The period is about 6 years and TGD predicts it correctly.

One can imagine that dark particles reside at the flux tubes connecting diametrically opposite points of the spherical layer. Particles would experience the sum of gravitational forces summing up to zero in the center of Earth. Although the layer would be almost invisible (or completely invisible by argument utilizing the analogy with conducting shell) gravitationally in its interior,  $h_{gr} = M_D m / v_0$  would make itself visible in the dynamics of dark particles! This layer could represent magnetic Mother Gaia and EEG would take care of communications to this layer.

The rotation velocity  $v_{rot,M} \simeq 2.1 \times v_{rot,E}$  of Moon around its axis is the first guess for the parameter  $v_0$  identifiable perhaps as rotation velocity of the spherical layer. A better guess is that the ratio  $r = v_0 / v_{rot,M}$  is the same as for Sun and as assumed above for Earth. This would give for the ratio of cyclotron frequency scales  $r = (B_{end} / B_{gal}) \times 2.1$ . 66.7 min, which corresponds to  $B_{gal} = .63$  nT, would correspond to .1 s. For this choice 1 Hz DNA cyclotron frequency would correspond 11.7 h rather near to 12 h. This encourages the hypothesis that 72 min is the counterpart of .1 s cyclotron time. The cyclotron time of DNA (very weakly dependent on the length of DNA double strand) in  $B_{gal}$  (or its minimum value) would be 12 h.

Magnetic body of Earth controlling bio-dynamics would be a dramatic manifestation of non-locality to say nothing about the control performed by galactic magnetic body.  $M_D$  would be associated with the magnetic Mother Gaia making life possible at Earth together with magnetic Mother Galactica. Both MBs would be in continual contact with biomolecules like ATP and the molecules for which ATP attaches or provides the phosphate. Metabolic energy would be used to this process. These MBs would be Goddesses directing its attention to tiny bio-molecules. If this picture is correct, the ideas about consciousness independent on material substrate and assignable to a running computer program can be safely forgotten.

### Model for the flux tube connections between biomolecules

A more concrete TGD based model for the flux tubes connections between molecules relies on the general ideas of TGD inspired quantum biology [K51].

- Biomolecules containing aromatic rings are known to play a fundamental role. For instance, most neurotransmitters and psychoactive drugs involve aromatic rings). All DNA nucleotides contain them and there are 4 proteins, which also have them. Trp and phe are of special importance and form a pair structurally analogous to a base pair in DNA strand. The rings are assumed to carry the analog of supra current and be in or at least be able to make transition to a state with large  $h_{eff} = n \times h$ . The delocalization of electron pairs in aromatic ring could be a signature of  $h_{eff} / h > 1$ .
- Trp-phe pairing [K51] would be responsible for information molecule-receptor pairing. Information molecule and receptor would be at the ends of flux tubes serving as communication lines, and the attachment of info molecule to receptor would fuse the two flux tubes to longer one. After that communication would become possible as dark photon signals and dark supra currents. Formation of info molecule-receptor complex would be like clicking icon generating a connection between computers in net. Info molecules would generate the communication channels - they would not yet be the signals. This distinguishes TGD view from standard neuroscience.

3. All quantum critical phenomena involve generation of large  $h_{eff}$  phases and changes of  $h_{eff}$  in the sense that their values are different at different ends of space-time surface at boundaries of CD. Folding emerges or disappears at QC possible in certain temperature range of width about 40 K and depending on pH. The flux tubes associated with phe and trp containing aromatic rings carrying "supra current" would become dark (either  $h \rightarrow h_{eff}$  or  $h_{eff} > h$  increases) and thus much longer and reconnect temporarily and force phe and trp in a close contact after the reverse transition inducing shortening. This is a general mechanism making biomolecules able to find each other in what looks like molecular soup in the eyes of standard biochemist. The contacts between amino-acids phe and trp formed in this manner would be structurally identical with the hydrogen bonding between members of DNA base pairs and they would fix the final folding pattern to high degree.

### Pollack's mechanism

The discovery of negatively charged exclusion zone formed in water bounded by gel phase has led Pollack to propose the notion of gel like fourth phase of water [L17, I45, I36] (see <http://tinyurl.com/oyhstc2>). The proposal is that the fourth phase corresponds to negatively charged regions - exclusion zones - with size up to 100-200 microns generated when energy is fed into the water - say as radiation, in particular solar radiation. The stoichiometry of the exclusion zone is  $H_{1.5}O$  and can be understood if every fourth proton is dark proton residing at the flux tubes of the MB assignable to the exclusion zone and outside it [L17] [K51].

This leads to a model for prebiotic cell as exclusion zone. Dark protons are proposed to form dark nuclear strings whose states can be grouped to groups corresponding to DNA, RNA, amino-acids, and tRNA and for which vertebrate genetic code is realized in a natural manner [K56, K40]. The voltage associated with the system defines the analog of membrane potential, and serves as a source of metabolic energy as in the case of ordinary metabolism. The energy is liberated in a reverse phase transition in which dark protons transform to ordinary ones. Dark proton strings serve as analogs of basic biopolymers and one can imagine analog of bio-catalysis with enzymes replaced with their dark analogs.

Pollack's exclusion zones (EZs) might for instance explain why DNA is negatively charged. EZs or their generalization could play fundamental role in metabolism with protons running through mitochondrial membrane being dark as also other biologically important ions involved. EZs could be important even in electrolysis and allow to explain what happens in cold fusion. These hypothesis could be tested.

### Remote DNA replication

The works of Luc Montagnier [I19] and Peter Gariaev [I34] suggests that remote replication of DNA is possible. The developments in the model of dark DNA allow to imagine a detailed mechanism for how water can represent DNA and how DNA could be transcribed to dark DNA - essentially the analog of DNA-RNA transcription would be in question. The transcription/association represents a rule and rules are represented in terms of negentropic entanglement (NE) in TGD framework with pairs of states in superposition representing the instances of the rule. Transition energy serves as a characterizer of a molecule - say DNA codon - and the entangled state is a superposition of pairs in which either molecule is excited or dark DNA codon is excited to higher cyclotron state with same energy: this requires tuning of the magnetic field and sufficiently large value of  $h_{eff}$  at the flux tube. NE would due to the exchange of dark photons: this corresponds to wave DNA aspect. Dark cyclotron photons also generate negatively charged exclusion zones (EZs) discovered by Pollack and in this process transform part of protons to dark ones residing at the magnetic flux tubes associated with EZs and forming dark proton sequences. This allows to identify a mechanism of remote replication.

The results of Montagnier and Gariaev strongly suggest that genetic code is representation by dark photons, presumably by frequencies. How genetic code could be represented in terms of frequencies? The TGD based model of music harmony [L16] [K73] (see <http://tinyurl.com/zg3aa7>) relies on the idea that 12-note scale is representable as a closed non-self-intersecting curve (Hamilton's cycle) at icosahedron having 12 vertices. The harmony assignable to a given

Hamilton's cycle is characterized in terms of 3-chords assignable to the 20 faces (triangles) of the icosahedron once the 12-note scale is represented as a particular Hamilton's cycle.

Remarkably, the number of amino-acids is also 20! One indeed ends up with a model in which  $20+20+20=60$  DNA codons are represented by 3-chords for a triplet of harmonies defined by Hamilton's cycles predicting correctly the numbers of DNAs coding for a given amino-acid for vertebrate code. One must however assume that also tetrahedral harmony is present to get 64 DNA codons rather than only 60. TActually two variants of the code are predicted and altogether one obtains the standard 20 amino-acids plus two additional ones identified as Pyl and Sec known to be realized in living matter.

In music realization DNA codons can be represented as 3 dark photons or phonons with appropriate frequency ratios. This representation could explain the findings of Montagnier and Gariaev. There is also a connection with TGD inspired theory of consciousness. Music both expresses and induces emotions. The proposal is that the representation of DNA codons in terms of triplets of sounds or dark photons defines molecular level representation of emotions. There is large number of different harmonies and they could represent different moods.

### 8.4.3 Metabolism

The TGD inspired view about metabolism is as a mechanism making possible transfer of NE from phosphates to ATP and further to receiver molecules. TGD leads to new ideas about photosynthesis and suggests that also animal cells can perform process analogous to photosynthesis. Also remote metabolism is possible and there is evidence that it indeed occurs.

#### Metabolic energy is needed to transfer NE

At deep level metabolic energy might correspond to NE and thus information. Conscious information would be thus the basic currency and the transfer of metabolic energy and metabolites would make possible transfer of NE. It could be transfer of systems consisting of negentropically entangled parts or it could be transfer of NE with larger system, even Earth. NMP would force the systems to fight for NE and this would lead to the fight for metabolic resources. The transfer of entanglement (NE) is basic mechanism in quantum computation and would mean in biology stealing of NE, the fundamental crime! Metabolism in TGD framework is discussed in detail in [K43].

I have considered three possible three possible identifications of NE.

1. NE could be small scale entanglement - say between parts of molecules. This option is not favored by the needed large values of  $h_{gr}$  and thus of mass  $M$ .
2. NE could be between nutrient and larger structure - say Earth, Sun, or some other large enough structure to give a value of  $h_{gr} = GMm/v_0$  guaranteeing that dark cyclotron energies (no dependence on mass  $m$ ) in the range of bio-photon energies (visible and UV) and guarantee that EEG frequencies correspond to these energies. This option discussed in [K66]. Nutrients would be carriers of both metabolic energy and NE. This option does not conform with the fact that even electrons can provide metabolic energy and in TGD framework therefore also NE for some bacteria (see <http://tinyurl.com/o8xqh6g>). This suggests that nutrients carry only the energy needed to transfer NE.
3. NE could be also between a larger structure and phosphate molecule added to ADP using metabolic energy. This option is the simplest one and would predict that phosphates are in unique role as standard entanglers to mass  $M$ . Any source of metabolic energy is in principle possible since metabolic energy is only needed to transfer the flux tube connecting phosphate to mass  $M$  to ADP so that ATP is obtained. The flux tube would represent the "high energy phosphate bond". ATP in turn attaches the flux tube to biomolecule, which becomes negentropically entangled. Metabolism would be make the transfer of NE possible. Metabolites would not contain information but it would be assignable to the flux tube between phosphate and mass  $M$ . Magnetic Mother Gaia would have very concrete meaning.

A good candidate for the larger structure could be a spherical layer at the distance of Moon from Earth would give correct value for  $h_{eff} = h_{gr}$  [K66].

### Pollack's mechanism and photosynthesis

An obvious idea is that Pollack's mechanism or its generalization is the predecessor of photosynthesis. The question is therefore whether photosynthesis could involve the formation of exclusion zones (EZs) by the analog of whether photosynthesis could involve the formation of exclusion zones (EZs) by the analog of Pollack's mechanism [L17, I45, I36] (see <http://tinyurl.com/oyhstc2> leading to charge separation taking place also in photosynthesis. Pollack's mechanism creates in presence of radiation and water bounded by a gel at the boundary of water and gel an EZ, which is a layer negatively charged water with effective stoichiometry  $H_{1.5}O$  consisting of layers with hexagonal structure. The TGD inspired proposal is that hydrogen bonded pairs of  $H_2O$  molecules are formed and that each of them loses one proton as dark proton at magnetic flux tubes outside EZ. The notion of many-sheeted space-time and topological field quantization are essential elements of the proposal. Same phenomenon could be caused also by irradiation by sun light.

The light dependent step  $2H_2O \rightarrow 4H^+ + 4e^- + O_2$  of photosynthesis pumps protons through thylakoid membranes (for an illustration see <http://tinyurl.com/ycecu6uf>). The electrons excited by photons of sunlight are transferred along electron transport chain and lose energy used to pump protons through the thylakoid membrane and being thus transferred from stroma to grana against electric gradient. ADP transforms to ATP as these protons return to back through ATP synthase. This step is repeated again and again.

Could dark protons created by the analog of Pollack's mechanism be involved with photosynthesis? In what step the protons are transformed to dark protons by this mechanism?

1. The model of cell membrane leads to a proposal that pumps and channels quite generally are dark magnetic flux tubes and protons (and also other ions) are transferred through them as dark protons (dark ions). This would imply almost dissipation-free transfer.
2. The protons are pumped as dark protons through the thylakoid membrane along dark magnetic flux tubes serving as pumps using the energy provided by electrons flowing down in the electron chain. The dark protons return from grana through ATP synthase as dark protons as ATP is generated and transform with some rate back to ordinary protons in stroma. Otherwise the fraction of dark protons would steadily increase.
3. This leaves two options under consideration. Already the step  $2H_2O \rightarrow 4H^+ + 4e^- + O_2$  step  $2H_2O \rightarrow 4H^+ + 4e^- + O_2$  creates dark protons by a generalization of Pollack's mechanism or this step creates ordinary protons transformed by Pollack's mechanism to dark protons as they are transferred to dark magnetic flux tubes serving as pumps. The first option looks more plausible.

### The analog of photosynthesis in animal cells

Visible and UV light can provide metabolic energy for animal cells. There are various light therapies (see <http://tinyurl.com/hescd3x>) using red or IR light, and they could basically provide metabolic energy. In [I21] (see <http://tinyurl.com/hgtaqr6>) it is reported that IR laser light depolarizes cell membranes implying stimulation. This could be understood if IR light corresponds to a Josephson frequency  $eV/m_e$  assignable to the cell membrane. Also visible light has similar effects and one can ask whether animal cells could perform the analog of photosynthesis using essentially same basic mechanism as used by plant cells.

What is interesting is the electron transport chain is involved also with the cellular respiration. Cells would act like plant cells and the analog of photosynthesis could be in question. This would explain the claims that the members of some religious cults can practically live utilizing only sunlight. I have actually proposed that analog of photosynthesis storing the energy by  $ADP + P_i \rightarrow ATP$  type process using standard machinery could be actually involved and transfer the energy of IR light to metabolic energy further distributed by ATP.

The metabolic machinery for cellular respiration contains so called oxidative phosphorylation (OP) as a basic step: OP adds to ADP a phosphate giving metabolic currency ATP. ATP in turn distributes the metabolic energy further. OP uses electron transport chain to transfer metabolic energy from NADH by  $NADH \rightarrow NAD^+ + H^+ + 2e^-$ . The electrons go through the electron transport chain as in photosynthesis and transfer protons outside the mitochondrial membrane

very much like through thylakoid membrane in photosynthesis. The protons return through ATP-synthase and induce  $ADP + P_i \rightarrow ATP$ .

The metabolic energy must come from somewhere and OP indeed follows Krebs cycle (see <http://tinyurl.com/p6599hq>) in which the energy is extracted from nutrients and given to the NADP molecule. The photon energy could be fed directly to OP electron transport chain just as photon energy is transferred to this chain in photosynthesis. The presence of electron transport chain is necessary and one must feed the electrons and protons to this chain somehow.

1. Could the analog of photosynthetic reaction  $2H_2O \rightarrow 4H^+ + 4e^- + O_2$  with visible photons replaced with IR photons produce dark protons? Whether this is energetically possible and whether the electrons have high enough energies to drive the dark protons through the membrane is far from clear. One can of course imagine, that the number of pumped protons per electron is lower than usually.
2. A mechanism that I have called quantum credit card or remote metabolism [K43] looks more plausible. The splitting  $2H_2O \rightarrow 4H^+ + 4e^- + O_2$  could occur - not by absorption of positive energy photon but by emission of negative dark IR photon with the energy of visible photon. Cell would actively suck metabolic energy from IR light source. The emitted dark negative energy IR photon would decay to ordinary IR photons in reverse time direction, which would look like fusion in standard time direction and is thermodynamically non-favoured. ZEO predicting kind of syntropic processes to occur in living matter would be an essential prerequisite.

### Remote metabolism

ZEO makes possible both arrows of geometric time in living matter so that negative energy signals in reversed time direction become possible and one must generalize thermodynamics by introducing the notion of syntropy introduced already by Fantappie [J64]. Active metabolism that I have referred to as quantum credit card mechanism or a remote metabolism [K43, K44] becomes possible: system gets positive energy as a recoil effect by sending negative energy dark photons to a source able to receive them. In ZEO based formulation of quantum measurement theory the generation of negative energy photons corresponds to a state function reduction creating self with reversed arrow of geometric time.

There are several examples where remote metabolism might be involved.

1. Some spiritual groups and also traditionally the people called saints are reported to survive by using only sunlight as their source of metabolic energy.
2. Sled dogs [I12] (see <http://tinyurl.com/zg9j3p9>) can run for several days without eating and no signatures of ordinary metabolism have been found. This phenomenon cannot of course be specific to sleigh dogs. Remote metabolism could explain the phenomenon as an extraction of metabolic energy from non-standard sources in absence of standard sources - say from the magnetic body associated with the collective formed by the dogs.
3. Yan Xin Qigong practitioners report that in so called Bigu state there is no need to eat solid food at all for days, weeks, months or even years. Western science is beginning to take Bigu state (<http://tinyurl.com/y7unnww4>) seriously [I5] and the first national conference on Bigu state was held at the Pennsylvania State University in 2000, with presenters such as Rustum Roy, founding director of Penn State's Materials Research Laboratory and Hans Peter Duerr, former director of the Max Planck Institute.
4. Callahan [I8] has reported that plants suffering under-nutrition can attract insects responsible for their pollination. Callahan has also reported that plants and insects communicate using infrared light which according to his findings serves as a sensor input in insect olfaction: also in this case quantum credit card mechanism building magnetic flux tube bridges guiding the insects to the plant might be at work. In the case of IR metabolism electrons could send to the energy source dark negative energy IR photons, which decay to ordinary IR photons. This would be an active variant of metabolism and time reversal of the usual mechanism.



5. Gut cells without mitochondria can survive (see <http://tinyurl.com/hqq79th>)!  $ADP \rightarrow ATP$  transformation should occur since ATP is the universal energy currency. Could it take place as remote metabolism by sending negative energy photons to the cells having the mitochondria. The electron transfer chain is preceded by Krebs cycle (see <http://tinyurl.com/p6599hq>) extracting the energy from nutrients: could the absorption of negative energy photons induce the decay of nutrient without transfer of energy to electron chain of the mitochondria. This would be like kicking laser from population reversed state to ground state by phase conjugate negative energy irradiation. The hungry gut cell without mitochondria would be allowed to eat in the table of the luckier ones. This is again one quantum objection against vulgar darwinism.

### Homeopathy, water memory, and immune systems

In [K40] a TGD based model of water memory and homeopathy is discussed. An important step in progress was due to Pollack's findings about exclusion zones of water explained in terms of fourth phase of water [L17]. Second step or progress was inspired by an anomaly claimed by Tajmar *et al* [E11, E6] and known as strong gravimagnetism. The attempt to understand the claim led to  $h_{eff} = h_{gr} = h_{em}$  hypothesis unifying two TGD views about the notion of hierarchy of Planck constants proposed to characterize the phases of dark matter.

If dark proton (nucleon) sequences realized genetic code [L24] (see <http://tinyurl.com/jgfj1be>), water would already realize genetic code at the level of dark matter and chemical realization would have evolved from this more fundamental realization.

In this framework [K40] the attempt to understand homeopathy leads to additional insights about about water as living system and about prebiotic life as being based on the dark realization of genetic code realized in terms of dark proton strings which are nothing than dark variants of nuclei. Formation of exclusion zones would be formation of primitive lifeforms and primitive form of metabolism. Homeopathy could be seen as a manifestation of a fundamental form of immune system based on the recognition of invader molecules using reconnection mechanism for magnetic flux tubes and on mimicking the braiding of the MBs of invader molecules using dark variants of proteins (later proteins) and eventually representing them symbolically in terms of dark DNA (later ordinary DNA) coding for the dark proteins. Genetic code might have geometric interpretation as coding for the 2-braiding of 3-D coordinate grids represented by magnetic flux tubes serving as the 4-D template coding not only for the structure of the organism but also its functions as spatio-temporal patterns. Protein folding would represent a behavior of protein and DNA would code also for it.

#### 8.4.4 Proposals for the Physical Realizations of Genetic Code

The view about evolution as a random process suggests that genetic code is pure accident. My own view is that something so fundamental as life cannot be based on pure randomness. TGD has led to several proposals for genetic code, its emergence, and various realizations based on purely mathematical considerations or inspired by physical ideas [K105]. One can argue that genetic code is realized in several ways just like bits can be represented in very many ways. Two especially interesting proposals have emerged. The first one is based on geometric model of music harmony involving icosahedral and tetrahedral geometries. Second model having two variants is based on dark nuclear strings. Both models predict correctly the numbers of DNA codons coding for a given amino-acid.

For the successful options entire codons rather than letters are represented. The difference between letter-wise representation and codon-wise representations is analogous to that between spoken and written languages. In spoken languages words are not analyzed further to letters.

1. The geometric theory of harmony [L16] represents codons as 3-chords without assigning fixed notes to A,T,C,G and explains also DNA-amino-acid correspondence.
2. For the first variant of dark nuclear string serves as analog of DNA strand. The map of codons to the dark nucleon states of dark nucleon consisting of dark  $u$  and  $d$  type quarks does the same and also predicts the degeneracies successfully.

This model can be modified by replacing  $u$  and  $d$  by dark nucleon states  $p$  and  $n$  without any change in predictions related to genetic code. The evidence that DNA codons indeed couple to dark nucleon states [L28] supports this option.

### Geometric Theory of Harmony and Genetic Code

The idea that the 12-note scale could allow mapping to a closed path going through all vertices of icosahedron having 12 vertices and not intersecting itself is attractive. Also the idea that the triangles defining the faces of the icosahedron could have interpretation as 3-chords defining the notion of harmony for a given chord deserves study. The paths in question are known as Hamiltonian cycles and there are 1024 of them [A1]. These paths can be classified topologically by the numbers of triangles containing 0, 1, or 2 edges belonging to the cycle representing the scale. Each topology corresponds to particular notion of harmony and there are several topological equivalence classes.

In the article [L19] I introduced the notion of Hamiltonian cycle as a mathematical model for musical harmony and also proposed a connection with biology: motivations came from two observations. The number of icosahedral vertices is 12 and corresponds to the number of notes in 12-note system and the number of triangular faces of icosahedron is 20, the number of amino-acids. This led to a group theoretical model of genetic code and replacement of icosahedron with tetra-icosahedron to explain also the 21st and 22nd amino-acid and solve the problem of simplest model due to the fact that the required Hamilton's cycle does not exist. The outcome was the notion of bioharmony.

All icosahedral Hamilton cycles with symmetries ( $Z_6, Z_4, Z_2^{rot}$  and  $Z_2^{refl}$ ) turned out to define harmonies consistent with the genetic code. In particular, it turned out that the symmetries of the Hamiltonian cycles allow to predict the basic numbers of the genetic code and its extension to include also 21st and 22nd amino-acids Pyl and Sec: there are actually two alternative codes - maybe DNA and its conjugate are talking different dialects! One also ends up with a proposal for what harmony is leading to non-trivial predictions both at DNA and amino-acid level.

The conjecture is that DNA codons correspond to 3-chords perhaps realized in terms of dark photons or even ordinary sound. There are 256 different bio-harmonies and these harmonies would give additional degrees of freedom not reducing to biochemistry. Music expresses and creates emotions and a natural conjecture is that these bio-harmonies are correlates of emotions/moods at bio-molecular level serving as building bricks of more complex moods. Representations of codons as chords with frequencies realized as those of dark photons and also sound is what suggests itself naturally. This together with adelic physics involving hierarchy of algebraic extensions of rationals would explain the mysterious looking connection between rational numbers defined by ratios of frequencies with emotions.

### Mapping DNA and Amino-Acids to Dark Nucleon States

Could dark nuclear strings provide a representation of the genetic code. The answer was totally unexpected: the states of dark nucleons formed from three quarks can be grouped to multiplets in one-one correspondence with 64 DNAs, 64 RNAs, and 20 amino-acids and there is natural mapping of DNA and RNA type states to amino-acid type states such that the numbers of DNAs/RNAs mapped to given amino-acid are same as for the vertebrate genetic code.

The dark model emerged from the attempts to understand water memory [K40]. The outcome was a totally unexpected finding [K56, K40]: the states of dark nucleons formed from three quarks connected by color bonds can be naturally grouped to multiplets in one-one correspondence with 64 DNAs, 64 RNAs, 20 amino-acids, and tRNA and there is natural mapping of DNA and RNA type states to amino-acid type states such that the numbers of DNAs/RNAs mapped to given amino-acid are same as for the vertebrate genetic code.

The basic idea is simple. The basic difference from the model of free nucleon is that the nucleons in question - maybe also nuclear nucleons - consist of 3 linearly ordered quarks - just as DNA codons consist of three nucleotides. One might therefore ask whether codons could correspond to dark nucleons obtained as open strings with 3 quarks connected by two color flux tubes or as closed triangles connected by 3 color flux tubes. Only the first option works without additional

assumptions. The codons in turn would be connected by color flux tubes having quantum numbers of pion or  $\eta$ .

This representation of the genetic would be based on entanglement rather than letter sequences. Could dark nucleons constructed as string of 3 quarks using color flux tubes realize 64 DNA codons? Could 20 amino-acids be identified as equivalence classes of some equivalence relation between 64 fundamental codons in a natural manner? The codons would be not be anymore separable to letters but entangled states of 3 quarks.

If this picture is correct, genetic code would be realized already at the level of dark nuclear physics and maybe even in ordinary nuclear physics if the nucleons of ordinary nuclear physics are linear nucleons. Chemical realization of genetic code would be induced from the fundamental realization in terms of dark nucleon sequences and vertebrate code would be the most perfect one. Chemistry would be kind of shadow of the dynamics of positively charged dark nucleon strings accompanying the DNA strands and this could explain the stability of DNA strand having 2 units of negative charge per nucleotide. Biochemistry might be controlled by the dark matter at flux tubes.

The ability of the model to explain genetic code in terms of spin pairing is an impressive achievement, which I still find difficult to take seriously.

1. The original model mapping codons to dark nucleon states assumed the overall charge neutrality of the dark proton strings: the idea was that the charges of color bonds cancel the total charge of dark nucleon so that all states  $uuu, uud, udd, ddd$  can be considered. The charge itself would not affect the representation of codons. Neutrality assumption is however not necessary. The interpretation as dark nucleus resulting from dark proton string could quite well lead to the formation the analog of ordinary nucleus via dark beta decays [L31] so that the dark nucleus could have charge. Isospin symmetry breaking is assumed so that neither quarks nor flux tubes are assigned to representations of strong  $SU(2)$ .

There is a possible objection. For ordinary baryon the mass of  $\Delta$  is much larger than that of proton. The mass splitting could be however much smaller for linear baryons if the mass scale of excitations scales as  $1/h_{eff}$  as indeed assumed in the model of dark nuclear strings [L21, L31].

2. The model assumes that the states of DNA can be described as tensor products of the four 3-quark states with spin content  $2 \otimes 2 \otimes 2 = 4 \oplus 2_1 \oplus 2_2$  with the states formed with the 3 spin triplet states  $3 \otimes 3 = 5 \oplus 3 \oplus 1$  with *singlet state dropped*. The means that flux tubes are spin 1 objects and only spin 2 and spin 1 objects are accepted in the tensor product. One could consider interpretation in terms of  $\rho$  meson type bonding or gluon type bonding. With these assumptions the tensor product  $(2 \otimes 2 \otimes 2) \otimes (5 \oplus 3)$  contains  $8 \times 8 = 64$  states identified as analogs of DNA codons.

The rejection of spin 0 pionic bonds looks strange. These would however occur as bonds connecting dark codons and could correspond to different p-adic length scale as suggested by the successful model of X boson [L34].

One can also ask why not identify dark nucleon as as closed triangle so that there would be 3 color bonds. In this case  $3 \otimes 3 \otimes 3$  would give 27 states instead of 8 ( $\oplus 1$ ). This option does not look promising.

3. The model assumes that amino-acids correspond to the states  $4 \times 5$  with  $4 \in \{4 \oplus 2 \oplus 2\}$  and  $5 \in \{5 \oplus 3\}$ . One could tensor product of spin 3/2 quark states and spin 2 flux tube states giving 20 states, the number of amino-acids!
4. Genetic code would be defined by projecting DNA codons with the same total quark and color bond spin projections to the amino-acid with the same (or opposite) spin projections. The attractive force between parallel vortices rotating in opposite directions serves as a metaphor for the idea. This hypothesis allow immediately the calculation of the degeneracies of various spin states. The code projects the states in  $(4 \oplus 2 \oplus 2) \otimes (5 \oplus 3)$  to the states of  $4 \times 5$  with same or opposite spin projection. This would give the degeneracies  $D(k)$  as products of numbers  $D_B \in \{1, 2, 3, 2\}$  and  $D_b \in \{1, 2, 2, 2, 1\}$ :  $D = D_B \times D_b$ . Only the observed degeneracies

$D = 1, 2, 3, 4, 6$  are predicted. The numbers  $N(k)$  of amino-acids coded by  $D$  codons would be

$$[N(1), N(2), N(3), N(4), N(6)] = [2, 7, 2, 6, 3] .$$

The correct numbers for vertebrate nuclear code are  $(N(1), N(2), N(3), N(4), N(6)) = (2, 9, 1, 5, 3)$ . Some kind of symmetry breaking must take place and should relate to the emergence of stopping codons. If one codon in second 3-plet becomes stopping codon, the 3-plet becomes doublet. If 2 codons in 4-plet become stopping codons it also becomes doublet and one obtains the correct result  $(2, 9, 1, 5, 3)!$

It is difficult to exaggerate the importance of this simple observation suggesting that genetic code is realized already at the level of dark or even ordinary nuclear physics and bio-chemistry is only a kind of shadow of dark matter physics.

### Mapping DNA and Amino-Acids to Dark 3-Nucleon States

The assumption that entire codon rather than letter corresponds to a state of dark proton does not conform with the model for the origin of purines as DNA nucleotides [L28] assuming that purines and in fact all nucleotides are combined with dark proton unless one assumes that 3 nucleotides combine with the same dark proton. This looks somewhat artificial but cannot be excluded.

Amazingly, the arguments of the model involve only the representations of rotation group and since  $p$  and  $n$  have same spin as  $u$  and  $d$ , the arguments generalize to 3- nucleon states  $(ppp, ppn, pnn, nnn)$  connected by two color bonds and organized to linear structures. Concerning genetic code, exactly the same predictions follow in the recent formulation of the model. In this case quark color is not present. One could however use the 1-dimensionality and the ordering of dark nucleons as already described.

This variant has several nice features. The model is consistent with the model for dark nucleon strings consisting of nucleons and color bonds between them. There is no need to introduce  $\Delta$  type nucleon states and colored states are not needed in fermionic sector. Color bonds must be colored if one wants ordinary bosonic statistics for flux tubes but here braid statistics might help. Colored bonds could of course have some important function.

### 8.4.5 Applications to neuroscience

Models of EEG and nerve pulse are basic applications of the notion of MB in neuroscience. The basis idea is that EEG and its fractal counterparts are communications to the various layers of MB having onion-like structure with cyclotron frequency correlating with the size of the layer. Josephson junctions about which basic example is cell membrane would communicate sensory information to MB as dark photons.

#### Experimental evidence for MB

The team led by Michael Tyszka, associate director of Caltech Brain Imaging Center, has however discovered that the resting state network seems to work normally in people born without corpus callosum [J46] (see <http://tinyurl.com/3gjhtgb>)! As if brain hemispheres were communicating by some other means than neural signalling! This finding challenges not only the views about the origin of brain synchrony as being created by neural circuits but also the models of autism and schizophrenia explaining them in terms of impaired communications between hemispheres.

The MB of entire brain controls it and could naturally do this via the intermediate control of brain hemispheres forcing them to operate in the same rhythm. Brain synchrony and resting network would not be produced by resonant neuro-circuits as usually believed but by the spatiotemporal coherence of the EEG radiation from the MB of entire brain forcing brain hemisphere MBs to oscillate in the same rhythm and in turning synchronizing the brain hemispheres [K69]. This would be like forcing soldiers to march in the same pace and brain hemispheres could cooperate without any neural communication between hemispheres. The communication between hemispheres would be needed for more refined collaboration involving “discussion” between hemispheres: hemispheres of a person without corpus callosum would be like soldiers obeying blindly the orders. This might be also an essential element of autism and schizophrenia.

### EEG as communications between MB and BB

The general model for EEG follows neatly from this picture combined with the general model of high  $T_c$  superconductivity [K71, K72]. A fractal hierarchy of EEGs and its generalizations identified in terms of generalized Josephson radiation is predicted with levels labeled by p-adic length scales and the value of  $\hbar$  at various levels of dark matter hierarchy [K29]. At macrolevel one can approximate neuronal and axonal (and also cell-) membrane as Josephson junction formed by the two lipid layers of the membrane. At microscopic level ionic pumps and channels defined by Josephson junctions involving magnetic flux tubes connecting interior and exterior of the cell.

“Generalized” means that Josephson frequency as energy difference  $E = ZeV/h_{eff}$  of Cooper pair for membrane potential is replaced with the sum of difference of cyclotron energies and  $E$ . This implies that the variations of membrane potential by oscillations and nerve pulses induced frequency modulation of the frequency of dark photons sent to the MB. This defines a coding of the information carried by nerve pulses do dark photons. Whale’s song represents a good analogy for the coding. Besides EEG one would have its counterparts for various organs, organelles and even cell.

### Nerve pulse

The basic hypothesis has been that quantum jump takes the resting potential below the threshold for the generation of nerve pulse [K74]. One can imagine several ways for how this could happen. Some years ago I learned that nerve pulse propagation seems to be an adiabatic process and thus does not dissipate: the authors propose that 2-D acoustic soliton is in question. Adiabaticity is what one expects if the ionic currents are dark currents (large  $\hbar$  and low dissipation) or even supra currents. Furthermore, Josephson currents are oscillatory so that no pumping is needed. Combining this input with the model of DNA as topological quantum computer (TQC) leads to a rather precise model for the generation of nerve pulse.

1. The system would consist of two superconductors - microtubule space-time sheet and the space-time sheet in cell exterior - connected by Josephson junctions represented by magnetic flux tubes defining also braiding in the model of tqc. The phase difference between two super-conductors would obey Sine-Gordon equation allowing both standing and propagating solitonic solutions. A sequence of rotating gravitational penduli coupled to each other would be the mechanical analog for the system. Soliton sequences having as a mechanical analog penduli rotating with constant velocity but with a constant phase difference between them would generate moving kHz synchronous oscillation. Also moving oscillations in EEG range can be considered and would require larger value of Planck constant in accordance with vision about evolution as gradual increase of Planck constant.

In the microscopic description continuous Josephson junction is replaced with a distribution of Josephson junctions defined by transmembrane proteins such acting as pumps and channels.

2. During nerve pulse one pendulum would be kicked so that it would start to oscillate instead of rotating and this oscillation pattern would move with the velocity of kHz soliton sequence. The velocity of kHz wave and nerve pulse is fixed by periodic boundary conditions at the ends of the axon implying that the time spent by the nerve pulse in traveling along axon is always a multiple of the same unit: this implies kHz synchrony. The model predicts the value of Planck constant for the magnetic flux tubes associated with Josephson junctions and the predicted force caused by the ionic Josephson currents is of correct order of magnitude for reasonable values of the densities of ions. The model predicts kHz em radiation as Josephson radiation generated by moving soliton sequences. EEG would also correspond to Josephson radiation: it could be generated either by moving or standing soliton sequences (latter are naturally assignable to neuronal cell bodies for which  $\hbar$  should be correspondingly larger): synchrony is predicted also now.
3. Nerve pulse itself would correspond to a phase transition changing the value of Planck constant  $h_{eff}$  at the either side or both sides of the cell membrane at the flux tube associated with the transmembrane protein. This would induce transition to a new ionic equilibrium since cyclotron energies for ions change. This transition would give rise to the change of the

membrane potential. Cyclotron energy difference would however dominate in the generalized Josephson energy. This phase transition should be adiabatic and should not require heat or generate it.

4. The view about microtubules in nerve pulse conduction can be sharpened. Microtubular electric field (always in the same direction) could explain why kHz and EEG waves and nerve pulse propagate always in same direction and might also feed energy to system so that solitonic velocity could be interpreted as drift velocity. This also inspires a generalization of the model of DNA as topological quantum computer (TQC) since also microtubule-cell membrane systems are good candidates for performers of TQC. Cell replication during which DNA is out of game seems to require this and microtubule-cell membrane tqc would represent higher level tqc distinguishing between multi-cellulars and mono-cellulars.
5. New physics would enter in several ways. Ions should form Bose-Einstein cyclotron condensates. The assumption of only bosonic ions leads to a highly predictive model. The new nuclear physics predicted by TGD predicts that ordinary fermionic ions (such as  $K^+$ ,  $Na^+$ ,  $Cl^-$ ) have bosonic chemical equivalents with slightly differing mass number. Anomalies of nuclear physics and cold fusion provide experimental support for the predicted new nuclear physics. Electronic supra current pulse from microtubules could induce the kick of pendulum inducing nerve pulse and induce a small heating and expansion of the axon. The return flux of ionic Josephson currents would induce convective cooling of the axonal membrane. A small transfer of small positive charge into the inner lipid layer could induce electronic supra current by attractive Coulomb interaction. The exchange of exotic  $W$  bosons which are scaled up variants of ordinary  $W^\pm$  bosons is a possible manner to achieve this if new nuclear physics is indeed present.

#### 8.4.6 Remote mental interactions

MB would be central for understanding of remote mental interactions as special case of those occurring between MB and biological body. Now the biological body would not be own biological body and could be even non-living system containing quantum critical parts. Remote mental interactions would not be anything exotic or special. In this framework [K97, K100] also hypnosis [L14] and psychedelic experiences [K95] might be seen as remote mental interactions.

#### Precognition, psychokinesis, telepathy

I have considered various remote mental interactions in the book [K97]. Much of the material has evolved via the panel discussions associated with Journal of Non-locality and I am grateful for Lian Sidorov and people working in her group for a fruitful collaboration during these years.

1. Magnetic flux tube pairs involving also MEs (“massless extremals” [K7, K62] as analogs of laser beams) connecting the sender and receiver make possible a universal mechanism for the transfer of intent and action. The pair of flux tubes forms a kind of sensory-motor loop. In biology the fundamental realization could be by a pair of flux sheets going through the strands of DNA with passive strand sending sensory data to the MB and active strand receiving control commands leading to various forms of gene expression. MEs are ideal for the transfer of both classical information and momentum.

This is not the only possible realization. For instance, one could think that the passive strands of DNA send sensory data to the MB of DNA and active strands of DNA receive control commands: time scale would be rather slow. Also the lipid layers of cell membrane could have similar division of labor and now the time scale could be that for nerve pulse.

2. The transfer of intent gives rise to mechanism of remote interaction which can act both endo- and exogenously. Magnetic flux tubes characterized by their fundamental frequencies make possible bridges between sender and receiver (say healer and healee) and allow a resonant interaction in which healer can initiate various control commands acting as 4-dimensional templates represented as holograms. Also smaller MEs can be send along the MEs serving as bridges (this is like throwing balls with light velocity!).

3. The MEs and magnetic flux tube pairs connecting sender and receiver can act as a reference wave which can initiate an arbitrarily complex hologram representing biological program. Sender has the ability to generate and amplify the frequencies which induce holograms representing the control commands. In particular, in living matter sender can initiate complex biological programs without knowing anything about their functioning.

One can distinguish between psychokinesis applied to living matter and inanimate matter.

1. When the target consists of living matter, the mechanisms would be same as in communications between magnetic and biological bodies making possible bio-control of biological body by MB and the receipt of sensory input from biological body by MB. Hypnosis would be one example of this kind of interaction.
2. Remote mental interactions in the case inanimate matter could use simpler variants of the fundamental mechanisms utilized in living matter. For instance, zero energy ontology assigns with the CD of electron and quarks time scales .1 s and 1 ms defining fundamental biorhythms. The CD assignable to elementary particles could be involved also with psychokinesis. NE could be essential for the transfer of metabolic energy (say in simple psychokinesis moving an object) and for control actions -say in intentional change of sequences of binary digits produced by random number generator. Target system would not be completely inanimate. Thermodynamical restrictions favor large values of Planck constant.

The basic problem in many remote mental interactions such as the intentional effect on random number generator is “Who knows how?”. How the mere intent can be transformed to action without any knowledge about the details of the action? The attempt to understand how neuro-feedback affect the behavior of single neuron leads to the same question.

1. Magnetic mirrors make possible also feedback and this feedback could make possible learning. For instance, in psychokinesis (especially so in micro PK), this learning would be crucial and analogous to that what occurs when we learn to drive a car. In healing this kind of feedback might help to find the healing frequency by trial and error.
2. It is quite possible that also multibrained and -bodied higher level collective selves actively participate in the process as a third party such that the remote mental interactions would act as a relay states. I have suggested similar explanation for Sheldrake’s findings about learning at the level of species and Tiller’s findings about the “transfer of intent”. This could make possible coherent amplification effects (TEM, prayer groups) and could make available information resources of all brains involved with the group. This could for instance explain the ability of a remote viewer to see an object on basis of data which need not have any meaning for her.
3. A fast amplitude modulation of alpha waves introducing higher harmonics to the carrier wave is a good candidate for mediating communication between brains and higher level multibrained selves. Mesoscopic “features” in brain involve precisely this kind of amplitude modulation and might represent just this kind of messages. Interestingly, also speech is produced by a fast amplitude modulation of 10 Hz basic vibration frequency of speech organs (assignable to electron CD as a fundamental frequency) and kHz (quarks) frequency is a special frequency from the point of view of hearing.

The article of J. Spottiswoode [J59] discusses two strange findings about remote mental interactions.

1. There is a statistical tendency of the anomalous cognition (AC) performance to concentrate in a 2 hour period around 13.30 of the local sidereal time (ST), which is the time measured using as a reference distant stars and thus running at a slightly different rate than the solar time: the lag is  $\Delta T = 24/365$  hours  $\sim 3.7$  minutes during 24 hours.
2. The anticorrelation between the level of geomagnetic fluctuations and AC performance has also a maximum during 2-hour period around  $\sim 13.30$  ST.

The fact that AC performance is associated with the same sidereal hour suggests the identification of the galactic magnetosphere as a conscious involved with remote cognition. For interstellar and galactic magnetic fields cyclotron time scales correspond to the time scales of human consciousness so that also these magnetic flux quanta could receive sensory input from biosphere and control it.

### Hypnosis as remote mental interaction

In TGD framework one can argue that hypnosis represents an example about the fact that brain is not “private property”: hypnotist uses the biological body and brain of the subject as instrument [L14]. Therefore remote mental interaction would be in question. This idea generalizes: if one accepts self hierarchy, one can assign to any kind of higher level structure - family, organization, species, .... - a higher level self and MB carrying dark matter, and these MBs can use lower level MBs as their instruments to realize their intentions. Biological bodies would be an important level in the hierarchy, which would continue down to cellular, molecular, and perhaps to even lower levels.

This view challenges the prevailing views about brain as a sole seat of consciousness and the assumption that conscious entities assigned with brains are completely isolated. Given MB can use several biological bodies although one can assign to it the one providing the sensory input - at least during wake-up state. Note however that it is easy to produce illusion that some foreign object is part of biological body.

For more than decade ago I proposed a model for so called bicamerality based on the notion of semitrance [K83]. In semitrance the brain of subject becomes partially entangled with a higher level self - in this case the self of family or more general social group uses the biological body of member for its purposes. Higher level self gives its commands and advice interpreted by the bicameral as “God’s voice”. The consciousness of schizophrenic might be basically bicameral. Also hypnotic state and dream consciousness are candidates for bicameral consciousness.

In [L14] I develop essentially this idea but using as input the recent understanding of about TGD inspired theory of consciousness and quantum biology and end up with a proposal for a detailed mechanism for how the MB hijacks some parts of the brain of the subject: prefrontal cortex and anterior cingulate cortex are argued to be the most plausible targets of hijacking. Also a mechanism explaining how the sensory hallucinations and motor actions are induced by hypnotist by inhibiting a halting mechanism preventing imagined motor actions to become real and sensory imagination to become “qualiafied”.

### Psychedelic experiences and time non-locality

There is a book about psychedelic induced experiences titled as “Inner paths to outer space” (<http://tinyurl.com/gnb4bp9>) written by Rick Strassman, Slawek Wojtowicz, Luis Eduardo Luna and Ede Frecska [J45]. The TGD inspired hypothesis [K100] goes as follows.

1. Psychedelics bind to the same receptors as the neurotransmitters with similar aromatic rings (weaker assumption is that neurotransmitters in question possess aromatic rings). This is presumably consistent with the standard explanation of the effect of classical psychedelics as a modification of serotonin uptake. This binding replaces the flux tube connection via neurotransmitter to some part of the personal MB with a connection via psychedelic to some other system, which might be even in outer space. A communication line is created making among other things possible remote sensory experiences.

Magnetic fields extending to arbitrary large distances in Maxwell’s theory are replaced with flux tubes in TGD framework. The MBs of psychedelics would carry very weak magnetic fields and would have very large  $h_{eff}$  - maybe serving as a kind of intelligence quotient.

2. This would be like replacing the connection to the nearby computer server with a connection to a server at the other side of the globe. This would affect the usual function of transmitter and possibly induce negative side effects. Clearly, TGD inspired hypothesis gives for the psychedelics much more active role than standard hypothesis.



3. Psychedelics can be classified into two groups depending on whether they contain derivative of amino-acid trp with two aromatic rings or phe with one aromatic ring. Also DNA nucleotide resp. its conjugate have 2 resp. 1 similar aromatic rings. This suggests that the coupling between information molecule and receptor is universal and same as the coupling between the two bases in DNA double strand and consists of hydrogen bonds. This hypothesis is testable since it requires that the trp:s/phe:s of the information molecule can be brought to same positions as phe:s/trp:s in the receptor. If also protein folding relies on this coupling, one might be able to predict the folding to a high degree.
4. A highly suggestive idea is that molecules with aromatic rings are fundamental conscious entities at the level of molecular biology, and that more complex conscious entities are created from them by reconnection of flux tubes. DNA/RNA sequences and microtubules would be basic examples about this architecture of consciousness. If so, protein folding would be dictated by the formation trp-phe contacts giving rise to larger conscious entities.

This model meets of course strong objection: finite light velocity does not allow communications with outer space in standard physics framework. In TGD framework ZEO changes the situation. Second objection is that the communications require huge amount of energy unless they are precisely targeted. The third objection is that quantum coherence in very long, even astrophysical scales is required. In TGD framework these objections do not apply.

## 8.5 Morphogenesis in TGD Universe

The problem of structure formation in biology - morphogenesis - was put under the rug by most biologists after the emergence of genetics. Shel Drake [L10, I39] is one of those who have taken it seriously and has been labelled as a crackpot by mainstreamers (I have discussed Shel Drake's views from TGD point of view in [L10, L25]). One just assumes that the structures are there and performs chemistry around these structures. This approach is very practical and has given an enormous amount of data but very little understanding.

In standard physics the description of spatial structures would be in terms of enhanced densities of biomolecules or of their gradients in some space-time region. This is the only possibility because the space-time of standard physics is topologically and geometrically utterly trivial. Empty Minkowski space is an excellent approximation for it.

What philosopher has to say about this? If space-time topology were topologically non-trivial, situation would change dramatically. Already Wheeler saw this possibility and in the biology inspired by TGD (for which Wheeler suggested its name) all structures correspond to structures of topologically non-trivial space-time identified as surface in certain 8-D space-time: space-time sheets, magnetic flux tubes, etc... The entire TGD inspired quantum biology relies on this vision. The structures that we see around us would represent the non-trivial topology of space-time surface.

All structures - including bio-molecules, membrane like structures, organelles, organs, ... - would be 4-D space-time surfaces. Again philosopher gets excited since this would reduce the notion of shape in biology to a precisely defined and testable geometrodynamics coupling to em fields.

### 8.5.1 The dynamics of space-time surfaces

This dynamics predicts two kinds of space-time regions [L23] (see <http://tinyurl.com/yboog5sr>).

1. The regions of first kind are locally minimal surfaces. These minimal surfaces are as 4-D analogs of geodesic lines analogs of asymptotic states of particle physics for which interactions are not on. They also satisfy non-linear geometrization of massless field equations so that both particle and wave aspects are present. What is especially important is that static minimal surfaces have vanishing mean curvature and look like saddles locally. They cannot be closed surface if stationary.
2. Second type of regions are not minimal surfaces: there is a non-trivial coupling of the minimal surface term to 4-force density analogous to the divergence of Maxwellian energy momentum

tensor. This is a generalization of the dynamics of a point-like charged particle in Maxwell field. These regions are identified as interaction regions: in particle physics these two regions correspond to external free particles and the interaction region. Magnetic flux tubes play fundamental role in TGD based quantum biology are deformations of string like objects, which represent simplest 4-D minimal surfaces.

Essential is the coupling between induced Kähler form (mathematically like Maxwell field) and the geometry of the surface: the divergence of energy momentum current assignable to the analog of cosmological term (4-volume) equals to the divergence of that assignable to Kähler action: this expresses local conservation of four-momentum. One could also speak about coupling between Kähler field and gravitational field: Penrose's intuition about the role of gravitation in biology would be correct.

When the coupling is absent, minimal surface property implies the separate vanishing of both divergences and separate conservation of corresponding energy-momenta. All the known extremals of Kähler action are minimal surfaces: this is due to their very simple algebraic properties making easy to discover them. Physically this correspond to quantum criticality: dynamics is universal and does not depend on coupling parameters.

### 8.5.2 General view about morphogenesis

These observations lead to a rather general view about morphogenesis.

1. The presence of the Kähler field (em field is sum of Kähler field and second term) makes possible flow equilibria such as cell membrane, which are not minimal surfaces. These surfaces can be closed and stationary making possible isolation from environment crucial for living organisms.

Spherical soap bubble is a good analogy: it is not minimal surface as the soap films spanned by frames are. They look locally like saddle surfaces with opposite external curvatures in two orthogonal directions, this implies that they cannot be closed surfaces. Bubble is not possible without a pressure difference  $\Delta p$  between the interior and exterior of the bubble: the blowing of the soap bubble generates  $\Delta p$ , and means external energy feed analogous to metabolic energy feed.

$\Delta p$  is analogous to a non-vanishing voltage  $V$  over cell membrane. The electric field of cell membrane and the energy feed providing the energy of electric field as metabolic energy are essential for the stability. More generally,  $V$  would generalize to non-vanishing of energy momentum tensor of Kähler field with non-vanishing divergence serving as a correlate for the energy transfer between Kähler and volume (gravitational) degrees of freedom.

This generalises to all morphologies, which correspond to closed surfaces. They necessarily involve both Kähler electric and magnetic fields coupling to the geometry to stabilize the morphology. This statement would give some content for the exaggerated claim that biology is nothing but electricity + Schrödinger equation that I heard during my first student year.

2. For instance, the presence of Kähler electric field can correspond to electric fields of cell membrane or along a part of body. If it is too weak, things go wrong in development. As was found decades ago, consciousness is lost if the electric field between frontal lobes and hindbrain gets too weak or has wrong direction [J22]. Cell dies if the membrane potential becomes zero and EEG disappears in death. Also microtubules have electric field along their axes essential for their existence.

Michael Levin and his collaborators [I29, I30, I43] have discovered further fascinating connections between electric fields and morphogenesis. One of the discoveries is that the electric fields of the embryo are controlled by neurons of the still developing brain (see <http://tinyurl.com/y77fcc7r>). This conforms with the view that neurons and their MBs correspond to a higher level in the hierarchy than ordinary cells and there take care of control in longer scales. The MB of the developing brain would be the controller.

3. A non-trivial coupling (four-momentum transfer) between the volume and Kähler degrees of freedom requires that the energy momentum currents have opposite and non-vanishing

divergences. For the energy momentum tensor of ordinary Maxwell field the divergence is proportional to the contraction of Maxwell current and Maxwell field so that the current must be non-non-vanishing.

In TGD the energy momentum tensor is replaced with energy momentum current allowing to have well-defined notion of energy momentum and corresponding conservation laws. Now the divergence contains two terms. The first one is the contraction  $Tr(T_K H^k)$  of energy momentum tensor  $T_K$  of Kähler action with the second fundamental form  $H^k$ : this term proportional to  $T_K$  is new. Second term is proportional to the contraction  $j_K J \nabla h^k$  of the induced Kähler form  $J$  with Kähler current  $j_K$  and gradients  $\nabla h^k$  of embedding space coordinates analogous the divergence of energy-momentum tensor  $j^\beta F^\alpha_\beta$  in the case of ordinary Maxwell action. One expects both terms to be non-vanishing.

For the mere Kähler action, which I believed for decades to determine the preferred extremals,  $j_K$  is either vanishing or light-like. In presence of coupling it can be both non-vanishing and time-like. The realization that cosmological term is present was forced by the twistor lift of TGD whose existence is possible only for  $H = M^4 \times CP_2$  [K101, L39].

4. The predicted stabilizing Kähler (and em) currents would naturally correspond to the DC currents flowing along the body in various scales discovered already by Becker [J78, J22] and found to be essential for the survival of the organism. In particular, Becker's DC currents are essential for the healing of wounds and in the regeneration of organs. In the first first aid stage of the healing DC currents are generated locally and after than central nervous system (CNS) takes care of the generation of the current (for TGD based discussion of Becker currents see [K70] (see <http://tinyurl.com/ydg6okkk>) or [K72]). Also this is easy to understand from the proposed stability criterion.

### 8.5.3 Quantitative view

The emergence of life would require the coupling between Kähler and volume degrees of freedom. The following gives a quantitative discussion based on p-adic length scale hypothesis and twistor lift of TGD [K101, K9].

1. The coefficient  $\Lambda/8\pi G \equiv 1/L^4$  of the volume term in the action is analogous to cosmological constant in general relativity. The predicted wrong sign of  $\Lambda$  is the stumbling block of superstring theories. In TGD framework the sign is correct.
2. p-Adic coupling constant evolution predicts that the cosmological constant depends on p-adic length scale  $L(k)$  characterizing the size scale of the Universe, most naturally as that of horizon size. In zero energy ontology (ZEO)  $L(k)$  is identifiable as the size scale of causal diamond (CD) [K9].

One important implication is a solution to the problem of cosmological constant. Although cosmological constant is huge at very early times (or more precisely, in very short p-adic length scales), it is small in the length scales of recent cosmology. The values of cosmological constant at smaller p-adic lengths scales are however visible also in the recent day physics in many-sheeted space-time and biology could make them visible as the following arguments show.

3. There are two paired p-adic length scales: short p-adic length scale  $L(k_1)$  and long p-adic length scale  $L(k)$ . The vacuum energy density  $\rho_{vac} = \Lambda/8\pi G$  is naturally proportional to  $1/L^4(k_1)$ . One has energy  $E = 1/L(k_1)$  per 3-volume  $L(k_1)^3$ .

$\rho_{vac} = \Lambda/8\pi G$  is also naturally proportional to  $1/GL^2(k)$  since  $\Lambda = x/L(k)^2$  is natural by dimensional considerations. If  $L(k)$  corresponds to the size scale of the horizon,  $\Lambda$  decreases during cosmic evolution and the problem of cosmological constant disappears. One has

$$\frac{1}{L^4(k_1)} = \frac{\Lambda}{8\pi G} \quad , \quad \frac{\Lambda}{8\pi} = \frac{x^2}{L^2(k)} \quad . \quad (8.5.1)$$

Here the p-adic length scale  $L(k)$  could characterize the p-adic size scale of CD.  $G = l_{Pl}^2$  is gravitational constant,  $l_{Pl}$  Planck length scale, and  $L = L(k_1)$  is a smaller length scale.  $L(k_1)$  expressible using the geometric mean

$$L(k_1) = \left(\frac{8\pi G}{\Lambda}\right)^{1/4} = x^{-1/2} \sqrt{L(k)l_{Pl}} . \quad (8.5.2)$$

of  $L(k)$  and Planck length  $l_{Pl}$  and allows an identification as a p-adic length scale for a suitable choices of the parameter  $x$  [K9]. One has  $(8\pi)^{1/4} \simeq 2.4$ .

What could this pairing of short and long p-adic length scales mean? The notion of magnetic body (MB) could provide an explanation. MB has onion-like layered structure with layers labelled by p-adic length scales up to some maximum size scale. This suggests that a biological structure with size scale  $L(k_1)$  has MB for which the largest layer has the size scale  $L(k)$ .  $L(k_1)$  would correspond to smallest length scale in the hierarchy. Both scales could correspond to size scales of CDs.

**Remark:** When  $L(k_1)$  is scaled by  $2^r$  ( $k_1 \rightarrow k_1 + r$ ),  $L(k)$  is scaled by  $2^{2r}$ , ( $k \rightarrow k + 2r$ ).

4. From the parameterization

$$\rho_{vac} = y \frac{H^2}{8\pi G} \quad (8.5.3)$$

of the dark energy density in terms of Hubble constant at given space-time sheets one obtains an estimate for the inverse of the Hubble constant  $H$ , which depends on space-time sheet in terms of  $L(k)$ , as

$$\frac{1}{H(k)} = \sqrt{\frac{y}{8\pi x}} L(k) . \quad (8.5.4)$$

$H(k)$  refers now to Hubble constant in given p-adic length scale characterizing a level in the hierarchy of space-time sheets and is *not* the ordinary Hubble constant defined in very long scales at GRT limit of TGD. Naturality suggests the condition  $\sqrt{\frac{y}{8\pi x}} = 1$ .

One expects that the coupling between Kähler action and volume term can be non-vanishing only if the two contributions to the energy momentum tensor are of the same order of magnitude. Otherwise minimal surface property takes care that field equations are satisfied, and one does not obtain closed membrane like structures crucial for life.

1. To achieve this, Kähler action  $\propto E^2 - B^2$  must be of the same order of magnitude as  $(\Lambda/8\pi G) \equiv x/GL^2(k)$  giving in the case of cell membrane for the Kähler electric field strength the rough estimate

$$E \sim \frac{\sqrt{x}}{l_{Pl}L(k)} . \quad (8.5.5)$$

**Remark:** The electric field of the cell membrane corresponds to  $E \sim 5 \times 10^{-4} \text{ eV}^2$  in the units of particle physicist ( $\hbar = 1$  and  $c = 1$ ) in which unit of distance is  $1/\text{eV}$  and one has  $1 \text{ m} \leftrightarrow 1.24 \times 10^6 \text{ eV}^{-1}$ .

2. If an estimate for the typical strength  $E$  of bio-electric field is given, one can get some idea about the length scale  $L(k)$  as

$$L(k) = \frac{\sqrt{x}}{l_{Pl}E} . \quad (8.5.6)$$

By feeding in Planck length  $l_{Pl} \sim 1.6 \times 10^{-35}$  m and the electric field  $E \sim 5 \times 10^6 V/m$  of the cell membrane, one obtains for the cell membrane the estimate

$$\begin{aligned} L(k) &\sim \sqrt{x} \times L_0 , & L_0 &= 1.1 \times 10^6 \text{ ly} . \\ L(k_1) &= x^{-1/4} L_1 , & L_1 &= \sqrt{l_{Pl} L_0} = 4.2 \times 10^{-7} \text{ m} . \end{aligned} \quad (8.5.7)$$

Note that  $L(k)$  scales as  $x^{1/2}$  and  $L(k_1)$  as  $x^{-1/4}$ .

3. The value of electric field for cell membrane is essential for the argument. If one wants to generalize the argument from cell membrane to other systems, one must have an idea about how it scales. Membrane potential is near the value for which the potential energy  $ZeV_0$  for a Cooper pair is slightly above the thermal energy at physiological temperature. Hence the possible magnetic flux tube assignable to membrane proteins acting as Josephson junctions through cell membrane carry weakest possible electric field: this conforms with metabolic economy. A natural generalization would be that for a flux tube of length  $L$  one has  $E = V_0/L$ . This gives the scalings

$$L(k) \propto \left(\frac{L}{L_c}\right) , \quad L(k_1) \propto \left(\frac{L}{L_c}\right)^{1/2} . \quad (8.5.8)$$

The value of the parameter  $x$  is open and one can make only guesses. Naturality would suggest that  $x$  is not too far from unity.

**Option I:** The size of the Milky Way is estimated to be about  $L_{MW} = 10^5$  ly.  $L(k) = L_{MW}$  would be obtained for  $x = .01$ . One should be however cautious with this estimate: also  $x \sim 1$  might be acceptable.

1. For  $L(k_1)$  the formula  $L(k_1) = x^{-1/2} \sqrt{L(k)l_{Pl}}$  gives for  $x = .01$

$$L(k_1) = 4 \text{ nm} .$$

This is near the p-adic length scale  $L(149) = 5$  nm assignable to the ordinary cell membrane. There are indeed indications that galactic year defines a biorhythm [?]. For  $x = 1$  giving  $L(k) = 10^6$  ly one would have  $L(k_1) = 1.26$  nm, which does not correspond to cell membrane length scale.

2. For the inverse of the Hubble constant  $H(149)$  one obtains for  $x = .01$  the estimate

$$\frac{1}{H(k)} \simeq 2\sqrt{\frac{y}{8\pi x}} L(k) . \quad (8.5.9)$$

$H(149)$  does not correspond to standard cosmological constant. One has  $H(149) = L(k)$  for  $y = 2\pi x = .0628$ .

3. The scaling  $L(k) \rightarrow 10^5 L(k)$  the size scale of the observed Universe about 15 Gly scales  $L(k_1 = 149)$  to  $L(k_1) = 1.3 \mu\text{m}$ , which corresponds to  $L(165) = 1.25 \mu\text{m}$  in a reasonable approximation ( $L(167) = 2.5 \mu\text{m}$  is the p-adic length scale of nuclear membrane). This scale would correspond to a distance through which one has membrane potential  $V_0$ . Could the size scales of galaxy and observed Universe indeed correspond to those of lipid layer of cell membrane and cell membrane?

**Option II:** One could argue that the long length scales correspond to the size scale of Earth. In TGD based view about EEG MB as onion-like structure has also layer with size scale of Earth radius  $R_E$ .

1. The condition that  $L(k) = R_E = 6.3 \times 10^6 \text{ m}$  gives  $x = 6.4 \times 10^{-16}$  and  $L(k_1) = 6.7 \text{ mm}$ .  $L(k_1)$  could characterize a brain structure involved in the generation of EEG. Note that the estimate assumes the electric field of cell membrane. One can argue that the value of  $x = 6.4 \times 10^{-16}$  is highly un-natural.
2. There are indications for the existence of life in Mars, whose radius is 1/2 of that for Earth.  $L(k)$  would scale down by 1/2 as also the cell membrane thickness. Could this be assumed also for the **Option I**? By the proposed criterion the strength of electric field  $E$  for cell membrane should be 2 times stronger than for Earthly cell (for same physiological temperature). For instance, membrane potential could be same but membrane thickness could be 1/2 of that for Earthly membrane.

Interestingly, the TGD based version of Expanding Earth model [L44, L43] predicts that Earth experienced a rapid expansion doubling its radius. Even more, neuronal cell membranes are 2 times thicker than ordinary cell membranes. Animals utilizing aerobic respiration emerged in Cambrian explosion and eventually also neurons and TGD suggests an explanation in terms of oxygenation as the life in underground oceans entered to the surface through the cracks generated by the expansion [L45].

#### 8.5.4 Morphogenesis in astrophysical scales?

The proposed general picture has interesting implications for the TGD view about stars and planets. Minimal surfaces have vanishing mean curvature vector  $H^k$  defined by the trace of the second fundamental form. The external curvatures sum up to zero and the surface looks like saddle surface locally. This strongly suggests that one cannot have (spherically symmetric) closed 3-surfaces obtained by taking two almost copies of 3-surface having a boundary and gluing them together along boundaries as the assumption that there are not boundaries requires. Could stars and planets be flow equilibria analogous to soap bubbles for which pressure difference is necessary and is provided by an external energy feed (blowing the bubble). When the energy feed ceases, the bubble collapses? The analogy with the stellar dynamics leading eventually to a collapse to a blackhole is obvious.

#### Morphogenesis and metabolic energy feed in astrophysical scales as explanation for some puzzling findings?

The analogy with morphogenesis could allow to build a more coherent picture from several puzzling observations related to TGD made during years.

1. One cannot obtain an embedding of Schwarzschild exterior metric without the presence of long range induced gauge field behaving like  $1/r^2$  [K104]. Any object with long range gravitational field must have also electroweak gauge charge. The charge can be made arbitrarily small but must be non-vanishing. The natural guess was that em charge - closely related to Kähler charge - is in question. If flow equilibrium analogous to soap bubble is in question, the charge must be Kähler charge with the energy momentum currents of Kähler field feeding energy to prevent gravitational collapse.
2. During 1990s I did considerable amount of work [K104] in attempts to construct spherically symmetric solutions of field equations using only Kähler action but failed. In this case, the

field equations state the vanishing of the divergences of energy-momentum and color currents. All known extremals of both Kähler action and its twistor lift involving also volume term analogous to cosmological term are minimal surfaces and extremals of both Kähler action and volume term.

The failure to discover extremals which are not minimal surface might be simply due to the fact that they are not simple. One can however ask whether there are actually no radially symmetric stationary extremals of Kähler action? Could volume term be needed to stabilize them?

3. 4-surfaces with vanishing induced Kähler field are necessarily minimal surfaces. The vanishing of induced Kähler field is however not necessary. In fact all known non-vacuum extremals of Kähler action are minimal surfaces. The known repertoire of minimal surfaces includes cosmic strings, massless extremals representing radiation, and  $CP_2$  type extremals with Euclidian signature of induced metric representing elementary particles. For these Kähler action is present but minimal surface field equations give extremal property separately in volume and Kähler degrees of freedom.

For  $CP_2$  type extremals having light-like geodesic  $X^1 \subset M^2$  as  $M^4 = M^2 \times E^2$  projection, deformations as holomorphic maps  $CP_2 \rightarrow E^2$  are not possible without a coupling between Kähler and volume degrees of freedom: the reason is that non-vanishing Kähler current is generated. For mere volume term they would be possible.

4. Cosmic strings would dominate in the very early cosmology before space-time as a 4-surface with 4-D  $M^4$  projection had emerged. The vision is that the thickening of their  $M^4$  projection during cosmic expansion generated Kähler magnetic flux tubes carrying magnetic monopole fluxes. The thickening of cosmic strings need not leave them minimal surfaces but one expects that this is true approximately.

The feed of energy and particles from flux tubes (suggesting that they are not minimal surfaces) would have generated visible matter and led to the formation of stars. The flux tubes would take the role of inflaton field in standard approach. Flux tubes would have also second role: they would carry the quanta of gravitational and gauge fields and thus would be mediators of various interactions.

Dark matter identified as phases with non-standard value of Planck constant  $h_{eff}/h_0 = n$  having purely number theoretical origin in adelic physics [L37, L38] would reside at magnetic flux tubes and the general vision about TGD inspired biology is that it controls the ordinary biomatter, which would involve metabolic energy feed as a stabilizer of the flow equilibrium. This picture suggests a generalization.

Consider as an example cosmic strings  $X^4 = X^2 \times S^2 \subset M^4 \times CP_2$ , where  $S^2$  is a geodesic sphere - either homologically trivial or non-trivial. Consider  $M^4$  deformations transversal to  $X^2$  expected to lead to a thickening of cosmic strings during cosmic evolution.

- (a) For homologically trivial  $S^2$  and  $X^2 = M^2 \subset M^4 = M^2 \times E^2$  holomorphic deformations  $S^2 \rightarrow E^2$  are minimal surface extremals with a vanishing induced Kähler form. It is plausible that these deformations generalize to transversal holomorphic deformations of  $X^4 = X^2 \times S^2 \subset M^4 \times CP_2$  if the normal spaces of  $X^2$  in  $M^2$  form an integrable distribution.
  - (b) For homologically non-trivial  $S^2$  and  $X^2 = M^2 \subset M^4 = M^2 \times E^2$  holomorphic deformations  $S^2 \rightarrow E^2$  with vanishing Kähler current and without genuine coupling between volume and Kähler degrees of freedom are not possible. This is true also for a general string world sheet  $X^2$ .
5. The vision about dark nucleosynthesis [L36], which emerged from the model of “cold fusion” has led to the proposal that dark nucleosynthesis preceded ordinary nucleosynthesis. Dark proton sequences were generated first by the analog of Pollack effect [L17], [L17] at magnetic flux tubes suffering also weak decays to produce states involving dark neutrons. These states decayed to dark nuclei with smaller value of  $h_{eff}/h = n$  and eventually this process led to the formation of ordinary nuclei. This process liberated practically all nuclear energy and

heated the system and led eventually to the ordinary nuclear fusion occurring in the cores of stars.

In living systems dark nuclei realized as dark proton sequences realize dark analogs of DNA, RNA, amino-acids, and tRNA and would provide the fundamental realization of the genetic code [L42, L41]. This picture predicts a hierarchy of dark nuclear physics and dark realizations of the genetic code and analogs of the basic biomolecules. Could biology be replaced by a hierarchy of “biologies” in a more general sense.

6. In the generalized biology stellar cores would provide metabolic energy realized basically as energy flow associated with Kähler field in stellar core making possible to realize star as an analog of cell membrane as flow equilibrium. Also the flow of Kähler charge, presumably in radial direction, would be involved if the energy momentum current of the induced Kähler field is non-vanishing and could relate to the mass loss of stars.

Even in the case of planets dark nucleosynthesis could provide a radial energy flow to guarantee stability. Nucleosynthesis could have occurred inside planets and have produced heavier nuclei. The standard picture about stars as providers of heavier elements and supernova explosions giving rise to fusion generating elements heavier than Fe could be wrong.

7. This picture conforms with what we know about dark matter. Dark matter would consist of  $h_{eff}/h_0 = n$  phases of ordinary matter at magnetic flux tubes. If also magnetic flux tubes are minimal surfaces in good approximation, gravitational degrees of freedom assignable to the volume action as analog of Einstein-Hilbert action and stringy action would not interact with Kähler degrees of freedom appreciably except in the events in which dark energy and matter are transformed to ordinary matter. These events could be induced by collisions of magnetic flux tubes. The energy exchange would be present only in systems not representable as minimal surfaces. Dark matter in TGD sense has key role in TGD inspired quantum biology.

### Blackhole collapse as an analog of biological death?

Before one can say something interesting about blackholes in this framework and must look more precisely what cosmic strings are. There are two kinds of cosmic strings identifiable as preferred extremals of form  $X^2 \times Y^2 \subset M^4 \times CP_2$ .  $X^2$  is minimal surface.

1.  $Y^2$  can be homologically non-trivial complex sub-manifold of  $CP_2$  for which second fundamental form vanishes identically. Induced Kähler form is non-vanishing and defines monopole flux. Both Kähler and volume term (cosmological constant term formally at least) contribute to energy density but the energy momentum currents and also tensors have vanishing divergence so that there is no energy flux between gravitational and Kähler degrees of freedom.
2.  $Y^2$  can be also homologically trivial geodesic sphere for which Kähler form and therefore Kähler energy density vanishes identically. In this case only cosmological constant  $\Lambda$  represents a non-vanishing contribution to the energy so that energy transfer between gravitational and Kähler degrees of freedom is trivially impossible.

What could happen in blackhole collapse?

1. Blackhole is not able to produce “metabolic energy” anymore and preserve the spherically symmetric configuration anymore. The outcome of blackhole collapse could be a highly folded flux tube very near to minimal surface or perhaps, or even a cosmic string. The latter option is not however necessary.
2. Is this string homologically non-trivial having large string tension or homologically trivial and almost vacuum for small values of  $\Lambda$ ? The huge mass density of blackhole does not favour the latter option. This leaves under consideration only the homologically non-trivial cosmic strings or their deformations to flux tubes.

The string tension for cosmic string is estimated to be a fraction of order  $10^{-7}$  about the effective string tension of order  $1/G$  determined by blackhole mass which is proportional to the Schwarzschild radius. Therefore the cosmic string should be spaghetti like structure inside



the horizon having length about  $10^7$  time the radius of blackhole. Note that TGD predicts also second horizon below Schwarzschild horizon: the signature of the induced metric becomes Euclidian at this horizon and this could explain the echoes claimed to be associated with the observed blackhole formation [L27, L48].

3. One could say that Big bang starting from homologically non-trivial cosmic strings would end with Big crunch ending with similar objects.

Living systems are conscious and there is indeed a strong analogy to TGD inspired theory of consciousness. One could say that the particular sub-cosmology corresponds to a conscious entity (many-sheeted space-time predicts a Russian doll hierarchy of them) which repeatedly lives and dies and re-incarnates with opposite arrow of time.

1. In zero energy ontology (ZEO) key role is played by causal diamonds (CDs) carrying analogs of initial and final states at their boundaries are in key role. The  $M^4$  projection of CD is intersection of future and past directed light-cones. The shape of CD strongly suggests Big Bang followed by Big Crunch.
2. TGD inspired theory of consciousness predicts that conscious entities - selves - correspond to a generalized Zeno effect. Self is identified as a sequence of “small” state function reductions (weak measurements) increasing gradually the size of CD by shifting the active boundary of CD farther away from that passive boundary which is not changed (Zeno effect).

The states at the active boundary are affected unlike those at the passive boundary. Self dies when the first “big” state function reduction to the active boundary occurs and the roles of the active and passive boundary are changed. The arrow of geometric time identified as the distance between the tips of CD changes and the CD starts to grow in opposite time direction. The evolution of self is a sequence of births and deaths followed by a re-incarnation.

3. In astrophysical context this evolution would be a sequence of lives beginning with a Big Bang and ending with a Big Crunch with two subsequent evolutions taking in opposite time directions. Somewhat like breathing. This breathing would take place in all scales and gradually lead to a development of sub-Universes as the size of CD increases.
4. In ZEO the first big state function reduction to active boundary of CD occurs when all weak measurements have been done and there are no observables commuting with the observables, whose eigenstates the states at the passive boundary are. Self dies and reincarnates.

One can also try to build a classical view about what happens. Measurement involves always a measurement interaction generating entanglement. Could the transfer of quantum numbers and conserved quantities (also color charges besides Poincare charges) between Kähler and volume degrees of freedom define the measurement interactions in practice. When this transfer vanishes, there is no measurement interaction and no further measurements are possible. Also metabolism ceases and self dies in biological sense.

# Chapter i

## Appendix

### A-1 Introduction

Originally this appendix was meant to be a purely technical summary of basic facts but in its recent form it tries to briefly summarize those basic visions about TGD which I dare to regard as stabilized. I have added illustrations making it easier to build mental images about what is involved and represented briefly the key arguments. This chapter is hoped to help the reader to get fast grasp about the concepts of TGD.

The basic properties of embedding space and related spaces are discussed and the relationship of  $CP_2$  to the standard model is summarized. The basic vision is simple: the geometry of the embedding space  $H = M^4 \times CP_2$  geometrizes standard model symmetries and quantum numbers. The assumption that space-time surfaces are basic objects, brings in dynamics as dynamics of 3-D surfaces based on the induced geometry. Second quantization of free spinor fields of  $H$  induces quantization at the level of  $H$ , which means a dramatic simplification.

The notions of induction of metric and spinor connection, and of spinor structure are discussed. Many-sheeted space-time and related notions such as topological field quantization and the relationship many-sheeted space-time to that of GRT space-time are discussed as well as the recent view about induced spinor fields and the emergence of fermionic strings. Also the relationship to string models is discussed briefly.

Various topics related to p-adic numbers are summarized with a brief definition of p-adic manifold and the idea about generalization of the number concept by gluing real and p-adic number fields to a larger book like structure analogous to adèle [L37, L38]. In the recent view of quantum TGD [L64], both notions reduce to physics as number theory vision, which relies on  $M^8 - H$  duality [L54, L55] and is complementary to the physics as geometry vision.

Zero energy ontology (ZEO) [L53] [K113] has become a central part of quantum TGD and leads to a TGD inspired theory of consciousness as a generalization of quantum measurement theory having quantum biology as an application. Also these aspects of TGD are briefly discussed.

### A-2 Embedding space $M^4 \times CP_2$

Space-times are regarded as 4-surfaces in  $H = M^4 \times CP_2$  the Cartesian product of empty Minkowski space - the space-time of special relativity - and compact 4-D space  $CP_2$  with size scale of order  $10^4$  Planck lengths. One can say that embedding space is obtained by replacing each point  $m$  of empty Minkowski space with 4-D tiny  $CP_2$ . The space-time of general relativity is replaced by a 4-D surface in  $H$  which has very complex topology. The notion of many-sheeted space-time gives an idea about what is involved.

**Fig. 1.** Embedding space  $H = M^4 \times CP_2$  as Cartesian product of Minkowski space  $M^4$  and complex projective space  $CP_2$ . <http://tgdtheory.fi/appfigures/Hoo.jpg>

Denote by  $M^4_+$  and  $M^4_-$  the future and past directed lightcones of  $M^4$ . Denote their intersection, which is not unique, by CD. In zero energy ontology (ZEO) [L53, L57] [K113] causal diamond

(CD) is defined as cartesian product  $CD \times CP_2$ . Often I use CD to refer just to  $CD \times CP_2$  since  $CP_2$  factor is relevant from the point of view of ZEO.

**Fig. 2.** Future and past light-cones  $M^4_+$  and  $M^4_-$ . Causal diamonds (CD) are defined as their intersections. <http://tgdtheory.fi/appfigures/futurepast.jpg>

**Fig. 3.** Causal diamond (CD) is highly analogous to Penrose diagram but simpler. <http://tgdtheory.fi/appfigures/penrose.jpg>

A rather recent discovery was that  $CP_2$  is the only compact 4-manifold with Euclidian signature of metric allowing twistor space with Kähler structure.  $M^4$  is in turn is the only 4-D space with Minkowskian signature of metric allowing twistor space with Kähler structure [A12] so that  $H = M^4 \times CP_2$  is twistorially unique.

One can loosely say that quantum states in a given sector of “world of classical worlds” (WCW) are superpositions of space-time surfaces inside CDs and that positive and negative energy parts of zero energy states are localized and past and future boundaries of CDs. CDs form a hierarchy. One can have CDs within CDs and CDs can also overlap. The size of CD is characterized by the proper time distance between its two tips. One can perform both translations and also Lorentz boosts of CD leaving either boundary invariant. Therefore one can assign to CDs a moduli space and speak about wave function in this moduli space.

In number theoretic approach it is natural to restrict the allowed Lorentz boosts to some discrete subgroup of Lorentz group and also the distances between the tips of CDs to multiples of  $CP_2$  radius defined by the length of its geodesic. Therefore the moduli space of CDs discretizes. The quantization of cosmic recession velocities for which there are indications, could relate to this quantization.

### A-2.1 Basic facts about $CP_2$

$CP_2$  as a four-manifold is very special. The following arguments demonstrate that it codes for the symmetries of standard models via its isometries and holonomies.

#### $CP_2$ as a manifold

$CP_2$ , the complex projective space of two complex dimensions, is obtained by identifying the points of complex 3-space  $C^3$  under the projective equivalence

$$(z^1, z^2, z^3) \equiv \lambda(z^1, z^2, z^3) . \tag{A-2.1}$$

Here  $\lambda$  is any non-zero complex number. Note that  $CP_2$  can be also regarded as the coset space  $SU(3)/U(2)$ . The pair  $z^i/z^j$  for fixed  $j$  and  $z^i \neq 0$  defines a complex coordinate chart for  $CP_2$ . As  $j$  runs from 1 to 3 one obtains an atlas of three coordinate charts covering  $CP_2$ , the charts being holomorphically related to each other (e.g.  $CP_2$  is a complex manifold). The points  $z^3 \neq 0$  form a subset of  $CP_2$  homeomorphic to  $R^4$  and the points with  $z^3 = 0$  a set homeomorphic to  $S^2$ . Therefore  $CP_2$  is obtained by “adding the 2-sphere at infinity to  $R^4$ ”.

Besides the standard complex coordinates  $\xi^i = z^i/z^3$ ,  $i = 1, 2$  the coordinates of Eguchi and Freund [A8] will be used and their relation to the complex coordinates is given by

$$\begin{aligned} \xi^1 &= z + it , \\ \xi^2 &= x + iy . \end{aligned} \tag{A-2.2}$$

These are related to the “spherical coordinates” via the equations

$$\begin{aligned} \xi^1 &= \text{rexp}(i\frac{(\Psi + \Phi)}{2})\text{cos}(\frac{\Theta}{2}) , \\ \xi^2 &= \text{rexp}(i\frac{(\Psi - \Phi)}{2})\text{sin}(\frac{\Theta}{2}) . \end{aligned} \tag{A-2.3}$$

The ranges of the variables  $r, \Theta, \Phi, \Psi$  are  $[0, \infty], [0, \pi], [0, 4\pi], [0, 2\pi]$  respectively.

Considered as a real four-manifold  $CP_2$  is compact and simply connected, with Euler number 3, Pontryagin number 3 and second  $b = 1$ .

**Fig. 4.**  $CP_2$  as manifold. <http://tgdtheory.fi/appfigures/cp2.jpg>

### Metric and Kähler structure of $CP_2$

In order to obtain a natural metric for  $CP_2$ , observe that  $CP_2$  can be thought of as a set of the orbits of the isometries  $z^i \rightarrow exp(i\alpha)z^i$  on the sphere  $S^5$ :  $\sum z^i \bar{z}^i = R^2$ . The metric of  $CP_2$  is obtained by projecting the metric of  $S^5$  orthogonally to the orbits of the isometries. Therefore the distance between the points of  $CP_2$  is that between the representative orbits on  $S^5$ .

The line element has the following form in the complex coordinates

$$ds^2 = g_{a\bar{b}} d\xi^a d\bar{\xi}^b , \quad (\text{A-2.4})$$

where the Hermitian, in fact Kähler metric  $g_{a\bar{b}}$  is defined by

$$g_{a\bar{b}} = R^2 \partial_a \partial_{\bar{b}} K , \quad (\text{A-2.5})$$

where the function  $K$ , Kähler function, is defined as

$$\begin{aligned} K &= \log(F) , \\ F &= 1 + r^2 . \end{aligned} \quad (\text{A-2.6})$$

The Kähler function for  $S^2$  has the same form. It gives the  $S^2$  metric  $dzd\bar{z}/(1+r^2)^2$  related to its standard form in spherical coordinates by the coordinate transformation  $(r, \phi) = (\tan(\theta/2), \phi)$ .

The representation of the  $CP_2$  metric is deducible from  $S^5$  metric is obtained by putting the angle coordinate of a geodesic sphere constant in it and is given

$$\frac{ds^2}{R^2} = \frac{(dr^2 + r^2 \sigma_3^2)}{F^2} + \frac{r^2(\sigma_1^2 + \sigma_2^2)}{F} , \quad (\text{A-2.7})$$

where the quantities  $\sigma_i$  are defined as

$$\begin{aligned} r^2 \sigma_1 &= \text{Im}(\xi^1 d\xi^2 - \xi^2 d\xi^1) , \\ r^2 \sigma_2 &= -\text{Re}(\xi^1 d\xi^2 - \xi^2 d\xi^1) , \\ r^2 \sigma_3 &= -\text{Im}(\xi^1 d\bar{\xi}^1 + \xi^2 d\bar{\xi}^2) . \end{aligned} \quad (\text{A-2.8})$$

$R$  denotes the radius of the geodesic circle of  $CP_2$ . The vierbein forms, which satisfy the defining relation

$$s_{kl} = R^2 \sum_A e_k^A e_l^A , \quad (\text{A-2.9})$$

are given by

$$\begin{aligned} e^0 &= \frac{dr}{F} , & e^1 &= \frac{r\sigma_1}{\sqrt{F}} , \\ e^2 &= \frac{r\sigma_2}{\sqrt{F}} , & e^3 &= \frac{r\sigma_3}{F} . \end{aligned} \quad (\text{A-2.10})$$

The explicit representations of vierbein vectors are given by

$$\begin{aligned}
e^0 &= \frac{dr}{F} , & e^1 &= \frac{r(\sin\Theta\cos\Psi d\Phi + \sin\Psi d\Theta)}{2\sqrt{F}} , \\
e^2 &= \frac{r(\sin\Theta\sin\Psi d\Phi - \cos\Psi d\Theta)}{2\sqrt{F}} , & e^3 &= \frac{r(d\Psi + \cos\Theta d\Phi)}{2F} .
\end{aligned}
\tag{A-2.11}$$

The explicit representation of the line element is given by the expression

$$ds^2/R^2 = \frac{dr^2}{F^2} + \frac{r^2}{4F^2}(d\Psi + \cos\Theta d\Phi)^2 + \frac{r^2}{4F}(d\Theta^2 + \sin^2\Theta d\Phi^2) .
\tag{A-2.12}$$

From this expression one finds that at coordinate infinity  $r = \infty$  line element reduces to  $\frac{r^2}{4F}(d\Theta^2 + \sin^2\Theta d\Phi^2)$  of  $S^2$  meaning that 3-sphere degenerates metrically to 2-sphere and one can say that  $CP_2$  is obtained by adding to  $R^4$  a 2-sphere at infinity.

The vierbein connection satisfying the defining relation

$$de^A = -V_B^A \wedge e^B ,
\tag{A-2.13}$$

is given by

$$\begin{aligned}
V_{01} &= -\frac{e^1}{r} , & V_{23} &= \frac{e^1}{r} , \\
V_{02} &= -\frac{e^2}{r} , & V_{31} &= \frac{e^2}{r} , \\
V_{03} &= (r - \frac{1}{r})e^3 , & V_{12} &= (2r + \frac{1}{r})e^3 .
\end{aligned}
\tag{A-2.14}$$

The representation of the covariantly constant curvature tensor is given by

$$\begin{aligned}
R_{01} &= e^0 \wedge e^1 - e^2 \wedge e^3 , & R_{23} &= e^0 \wedge e^1 - e^2 \wedge e^3 , \\
R_{02} &= e^0 \wedge e^2 - e^3 \wedge e^1 , & R_{31} &= -e^0 \wedge e^2 + e^3 \wedge e^1 , \\
R_{03} &= 4e^0 \wedge e^3 + 2e^1 \wedge e^2 , & R_{12} &= 2e^0 \wedge e^3 + 4e^1 \wedge e^2 .
\end{aligned}
\tag{A-2.15}$$

Metric defines a real, covariantly constant, and therefore closed 2-form  $J$

$$J = -is_{a\bar{b}}d\xi^a d\bar{\xi}^b ,
\tag{A-2.16}$$

the so called Kähler form. Kähler form  $J$  defines in  $CP_2$  a symplectic structure because it satisfies the condition

$$J^k_r J^{rl} = -s^{kl} .
\tag{A-2.17}$$

The condition states that  $J$  and  $g$  give representations of real unit and imaginary units related by the formula  $i^2 = -1$ .

Kähler form is expressible locally in terms of Kähler gauge potential

$$J = dB ,
\tag{A-2.18}$$

where  $B$  is the so called Kähler potential, which is not defined globally since  $J$  describes homological magnetic monopole.

$dJ = ddB = 0$  gives the topological half of Maxwell equations (vanishing of magnetic charges and Faraday's induction law) and self-duality  $*J = J$  reduces the remaining equations to  $dJ = 0$ . Hence the Kähler form can be regarded as a curvature form of a  $U(1)$  gauge potential  $B$  carrying a magnetic charge of unit  $1/2g$  ( $g$  denotes the gauge coupling).

The magnetic flux of  $J$  through a 2-surface in  $CP_2$  is proportional to its homology equivalence class, which is integer valued. The explicit representations of  $J$  and  $B$  are given by

$$\begin{aligned} B &= 2re^3 , \\ J &= 2(e^0 \wedge e^3 + e^1 \wedge e^2) = \frac{r}{F^2} dr \wedge (d\Psi + \cos\Theta d\Phi) + \frac{r^2}{2F} \sin\Theta d\Theta \wedge d\Phi . \end{aligned} \quad (\text{A-2.19})$$

The vierbein curvature form and Kähler form are covariantly constant and have in the complex coordinates only components of type (1, 1).

Useful coordinates for  $CP_2$  are the so called canonical (or symplectic or Darboux) coordinates in which the Kähler potential and Kähler form have very simple expressions

$$\begin{aligned} B &= \sum_{k=1,2} P_k dQ_k , \\ J &= \sum_{k=1,2} dP_k \wedge dQ_k . \end{aligned} \quad (\text{A-2.20})$$

The relationship of the canonical coordinates to the “spherical” coordinates is given by the equations

$$\begin{aligned} P_1 &= -\frac{1}{1+r^2} , \\ P_2 &= -\frac{r^2 \cos\Theta}{2(1+r^2)} , \\ Q_1 &= \Psi , \\ Q_2 &= \Phi . \end{aligned} \quad (\text{A-2.21})$$

### Spinors In $CP_2$

$CP_2$  doesn't allow spinor structure in the conventional sense [A6]. However, the coupling of the spinors to a half odd multiple of the Kähler potential leads to a respectable spinor structure. Because the delicacies associated with the spinor structure of  $CP_2$  play a fundamental role in TGD, the arguments of Hawking are repeated here.

To see how the space can fail to have an ordinary spinor structure consider the parallel transport of the vierbein in a simply connected space  $M$ . The parallel propagation around a closed curve with a base point  $x$  leads to a rotated vierbein at  $x$ :  $e^A = R_B^A e^B$  and one can associate to each closed path an element of  $SO(4)$ .

Consider now a one-parameter family of closed curves  $\gamma(v) : v \in (0, 1)$  with the same base point  $x$  and  $\gamma(0)$  and  $\gamma(1)$  trivial paths. Clearly these paths define a sphere  $S^2$  in  $M$  and the element  $R_B^A(v)$  defines a closed path in  $SO(4)$ . When the sphere  $S^2$  is contractible to a point e.g., homologically trivial, the path in  $SO(4)$  is also contractible to a point and therefore represents a trivial element of the homotopy group  $\Pi_1(SO(4)) = Z_2$ .

For a homologically nontrivial 2-surface  $S^2$  the associated path in  $SO(4)$  can be homotopically nontrivial and therefore corresponds to a nonclosed path in the covering group  $\text{Spin}(4)$  (leading from the matrix 1 to -1 in the matrix representation). Assume this is the case.

Assume now that the space allows spinor structure. Then one can parallel propagate also spinors and by the above construction associate a closed path of  $\text{Spin}(4)$  to the surface  $S^2$ . Now, however this path corresponds to a lift of the corresponding  $SO(4)$  path and cannot be closed. Thus one ends up with a contradiction.

From the preceding argument it is clear that one could compensate the non-allowed  $-1$ -factor associated with the parallel transport of the spinor around the sphere  $S^2$  by coupling it to a gauge potential in such a way that in the parallel transport the gauge potential introduces a compensating  $-1$ -factor. For a  $U(1)$  gauge potential this factor is given by the exponential

$\exp(i2\Phi)$ , where  $\Phi$  is the magnetic flux through the surface. This factor has the value  $-1$  provided the  $U(1)$  potential carries half odd multiple of Dirac charge  $1/2g$ . In case of  $CP_2$  the required gauge potential is half odd multiple of the Kähler potential  $B$  defined previously. In the case of  $M^4 \times CP_2$  one can in addition couple the spinor components with different chiralities independently to an odd multiple of  $B/2$ .

**Geodesic sub-manifolds of  $CP_2$**

Geodesic sub-manifolds are defined as sub-manifolds having common geodesic lines with the embedding space. As a consequence the second fundamental form of the geodesic manifold vanishes, which means that the tangent vectors  $h_\alpha^k$  (understood as vectors of  $H$ ) are covariantly constant quantities with respect to the covariant derivative taking into account that the tangent vectors are vectors both with respect to  $H$  and  $X^4$ .

In [A17] a general characterization of the geodesic sub-manifolds for an arbitrary symmetric space  $G/H$  is given. Geodesic sub-manifolds are in 1-1-correspondence with the so called Lie triple systems of the Lie-algebra  $g$  of the group  $G$ . The Lie triple system  $t$  is defined as a subspace of  $g$  characterized by the closedness property with respect to double commutation

$$[X, [Y, Z]] \in t \text{ for } X, Y, Z \in t . \tag{A-2.22}$$

$SU(3)$  allows, besides geodesic lines, two nonequivalent (not isometry related) geodesic spheres. This is understood by observing that  $SU(3)$  allows two nonequivalent  $SU(2)$  algebras corresponding to subgroups  $SO(3)$  (orthogonal  $3 \times 3$  matrices) and the usual isospin group  $SU(2)$ . By taking any subset of two generators from these algebras, one obtains a Lie triple system and by exponentiating this system, one obtains a 2-dimensional geodesic sub-manifold of  $CP_2$ .

Standard representatives for the geodesic spheres of  $CP_2$  are given by the equations

$$S_I^2 : \xi^1 = \bar{\xi}^2 \text{ or equivalently } (\Theta = \pi/2, \Psi = 0) ,$$

$$S_{II}^2 : \xi^1 = \xi^2 \text{ or equivalently } (\Theta = \pi/2, \Phi = 0) .$$

The non-equivalence of these sub-manifolds is clear from the fact that isometries act as holomorphic transformations in  $CP_2$ . The vanishing of the second fundamental form is also easy to verify. The first geodesic manifold is homologically trivial: in fact, the induced Kähler form vanishes identically for  $S_I^2$ .  $S_{II}^2$  is homologically nontrivial and the flux of the Kähler form gives its homology equivalence class.

**A-2.2  $CP_2$  geometry and Standard Model symmetries**

**Identification of the electro-weak couplings**

The delicacies of the spinor structure of  $CP_2$  make it a unique candidate for space  $S$ . First, the coupling of the spinors to the  $U(1)$  gauge potential defined by the Kähler structure provides the missing  $U(1)$  factor in the gauge group. Secondly, it is possible to couple different  $H$ -chiralities independently to a half odd multiple of the Kähler potential. Thus the hopes of obtaining a correct spectrum for the electromagnetic charge are considerable. In the following it will be demonstrated that the couplings of the induced spinor connection are indeed those of the GWS model [B10] and in particular that the right handed neutrinos decouple completely from the electro-weak interactions.

To begin with, recall that the space  $H$  allows to define three different chiralities for spinors. Spinors with fixed  $H$ -chirality  $e = \pm 1$ ,  $CP_2$ -chirality  $l, r$  and  $M^4$ -chirality  $L, R$  are defined by the condition

$$\begin{aligned} \Gamma\Psi &= e\Psi , \\ e &= \pm 1 , \end{aligned} \tag{A-2.23}$$

where  $\Gamma$  denotes the matrix  $\Gamma_9 = \gamma_5 \otimes \gamma_5$ ,  $1 \otimes \gamma_5$  and  $\gamma_5 \otimes 1$  respectively. Clearly, for a fixed  $H$ -chirality  $CP_2$ - and  $M^4$ -chiralities are correlated.

The spinors with  $H$ -chirality  $e = \pm 1$  can be identified as quark and lepton like spinors respectively. The separate conservation of baryon and lepton numbers can be understood as a consequence of generalized chiral invariance if this identification is accepted. For the spinors with a definite  $H$ -chirality one can identify the vielbein group of  $CP_2$  as the electro-weak group:  $SO(4)$  having as its covering group  $SU(2)_L \times SU(2)_R$ .

The covariant derivatives are defined by the spinorial connection

$$A = V + \frac{B}{2}(n_+ 1_+ + n_- 1_-) . \quad (\text{A-2.24})$$

Here  $V$  and  $B$  denote the projections of the vielbein and Kähler gauge potentials respectively and  $1_{+(-)}$  projects to the spinor  $H$ -chirality  $+(-)$ . The integers  $n_{\pm}$  are odd from the requirement of a respectable spinor structure.

The explicit representation of the vielbein connection  $V$  and of  $B$  are given by the equations

$$\begin{aligned} V_{01} &= -\frac{e^1}{r_2} , & V_{23} &= \frac{e^1}{r_2} , \\ V_{02} &= -\frac{e^2}{r} , & V_{31} &= \frac{e^2}{r} , \\ V_{03} &= (r - \frac{1}{r})e^3 , & V_{12} &= (2r + \frac{1}{r})e^3 , \end{aligned} \quad (\text{A-2.25})$$

and

$$B = 2re^3 , \quad (\text{A-2.26})$$

respectively. The explicit representation of the vielbein is not needed here.

Let us first show that the charged part of the spinor connection couples purely left handedly. Identifying  $\Sigma_3^0$  and  $\Sigma_2^1$  as the diagonal (neutral) Lie-algebra generators of  $SO(4)$ , one finds that the charged part of the spinor connection is given by

$$A_{ch} = 2V_{23}I_L^1 + 2V_{13}I_L^2 , \quad (\text{A-2.27})$$

where one have defined

$$\begin{aligned} I_L^1 &= \frac{(\Sigma_{01} - \Sigma_{23})}{2} , \\ I_L^2 &= \frac{(\Sigma_{02} - \Sigma_{13})}{2} . \end{aligned} \quad (\text{A-2.28})$$

$A_{ch}$  is clearly left handed so that one can perform the identification of the gauge potential as

$$W^{\pm} = \frac{2(e^1 \pm ie^2)}{r} , \quad (\text{A-2.29})$$

where  $W^{\pm}$  denotes the charged intermediate vector boson.

The covariantly constant curvature tensor is given by

$$\begin{aligned} R_{01} &= -R_{23} = e^0 \wedge e^1 - e^2 \wedge e^3 , \\ R_{02} &= -R_{31} = e^0 \wedge e^2 - e^3 \wedge e^1 , \\ R_{03} &= 4e^0 \wedge e^3 + 2e^1 \wedge e^2 , \\ R_{12} &= 2e^0 \wedge e^3 + 4e^1 \wedge e^2 . \end{aligned} \quad (\text{A-2.30})$$

The charged part of the curvature tensor is left handed.

This is to be compared with the Weyl tensor, which defines a representation of quaternionic imaginary units.



$$\begin{aligned}
W_{03} = W_{12} &\equiv 2I_3 = 2(e^0 \wedge e^3 + e^1 \wedge e^2) , \\
W_{01} = W_{23} &\equiv I_1 = -e^0 \wedge e^1 - e^2 \wedge e^3 , \\
W_{02} = W_{31} &\equiv I_2 = -e^0 \wedge e^2 - e^3 \wedge e^1 .
\end{aligned} \tag{A-2.31}$$

The charged part of the Weyl tensor is right-handed and that the relative sign of the two terms in the curvature tensor and Weyl tensor are opposite.

Consider next the identification of the neutral gauge bosons  $\gamma$  and  $Z^0$  as appropriate linear combinations of the two functionally independent quantities

$$\begin{aligned}
X &= re^3 , \\
Y &= \frac{e^3}{r} ,
\end{aligned} \tag{A-2.32}$$

appearing in the neutral part of the spinor connection. We show first that the mere requirement that photon couples vectorially implies the basic coupling structure of the GWS model leaving only the value of Weinberg angle undetermined.

To begin with let us define

$$\begin{aligned}
\bar{\gamma} &= aX + bY , \\
\bar{Z}^0 &= cX + dY ,
\end{aligned} \tag{A-2.33}$$

where the normalization condition

$$ad - bc = 1 ,$$

is satisfied. The physical fields  $\gamma$  and  $Z^0$  are related to  $\bar{\gamma}$  and  $\bar{Z}^0$  by simple normalization factors.

Expressing the neutral part of the spinor connection in term of these fields one obtains

$$\begin{aligned}
A_{nc} &= [(c+d)2\Sigma_{03} + (2d-c)2\Sigma_{12} + d(n_+1_+ + n_-1_-)]\bar{\gamma} \\
&+ [(a-b)2\Sigma_{03} + (a-2b)2\Sigma_{12} - b(n_+1_+ + n_-1_-)]\bar{Z}^0 .
\end{aligned} \tag{A-2.34}$$

Identifying  $\Sigma_{12}$  and  $\Sigma_{03} = 1 \times \gamma_5 \Sigma_{12}$  as vectorial and axial Lie-algebra generators, respectively, the requirement that  $\gamma$  couples vectorially leads to the condition

$$c = -d . \tag{A-2.35}$$

Using this result plus previous equations, one obtains for the neutral part of the connection the expression

$$A_{nc} = \gamma Q_{em} + Z^0 (I_L^3 - \sin^2 \theta_W Q_{em}) . \tag{A-2.36}$$

Here the electromagnetic charge  $Q_{em}$  and the weak isospin are defined by

$$\begin{aligned}
Q_{em} &= \Sigma^{12} + \frac{(n_+1_+ + n_-1_-)}{6} , \\
I_L^3 &= \frac{(\Sigma^{12} - \Sigma^{03})}{2} .
\end{aligned} \tag{A-2.37}$$

The fields  $\gamma$  and  $Z^0$  are defined via the relations

$$\begin{aligned}
\gamma &= 6d\bar{\gamma} = \frac{6}{(a+b)}(aX + bY) , \\
Z^0 &= 4(a+b)\bar{Z}^0 = 4(X - Y) .
\end{aligned} \tag{A-2.38}$$

The value of the Weinberg angle is given by

$$\sin^2\theta_W = \frac{3b}{2(a+b)} , \quad (\text{A-2.39})$$

and is not fixed completely. Observe that right handed neutrinos decouple completely from the electro-weak interactions.

The determination of the value of the Weinberg angle is a dynamical problem. The original approach was based on the assumption that it makes sense to talk about electroweak action defined at fundamental level and introduce a symmetry breaking by adding an additional term proportional to Kähler action. The recent view is that Kähler action plus volume term defines the fundamental action.

The Weinberg angle is completely fixed if one requires that the electroweak action contains no cross term of type  $\gamma Z^0$ . This leads to a definite value for the Weinberg angle.

One can however add a symmetry breaking term proportional to Kähler action and this changes the value of the Weinberg angle. As a matter fact, color gauge action identifying color gauge field as proportional to  $H^A J_{\alpha\beta}$  is proportional to Kähler action. A possible interpretation would be as a sum of electroweak and color gauge interactions.

To evaluate the value of the Weinberg angle one can express the neutral part  $F_{nc}$  of the induced gauge field as

$$F_{nc} = 2R_{03}\Sigma^{03} + 2R_{12}\Sigma^{12} + J(n_+1_+ + n_-1_-) , \quad (\text{A-2.40})$$

where one has

$$\begin{aligned} R_{03} &= 2(2e^0 \wedge e^3 + e^1 \wedge e^2) , \\ R_{12} &= 2(e^0 \wedge e^3 + 2e^1 \wedge e^2) , \\ J &= 2(e^0 \wedge e^3 + e^1 \wedge e^2) , \end{aligned} \quad (\text{A-2.41})$$

in terms of the fields  $\gamma$  and  $Z^0$  (photon and  $Z$ - boson)

$$F_{nc} = \gamma Q_{em} + Z^0(I_L^3 - \sin^2\theta_W Q_{em}) . \quad (\text{A-2.42})$$

Evaluating the expressions above, one obtains for  $\gamma$  and  $Z^0$  the expressions

$$\begin{aligned} \gamma &= 3J - \sin^2\theta_W R_{12} , \\ Z^0 &= 2R_{03} . \end{aligned} \quad (\text{A-2.43})$$

For the Kähler field one obtains

$$J = \frac{1}{3}(\gamma + \sin^2\theta_W Z^0) . \quad (\text{A-2.44})$$

Expressing the neutral part of the symmetry broken YM action

$$\begin{aligned} L_{ew} &= L_{sym} + f J^{\alpha\beta} J_{\alpha\beta} , \\ L_{sym} &= \frac{1}{4g^2} Tr(F^{\alpha\beta} F_{\alpha\beta}) , \end{aligned} \quad (\text{A-2.45})$$

where the trace is taken in spinor representation, in terms of  $\gamma$  and  $Z^0$  one obtains for the coefficient  $X$  of the  $\gamma Z^0$  cross term (this coefficient must vanish) the expression

$$\begin{aligned} X &= -\frac{K}{2g^2} + \frac{fp}{18} , \\ K &= Tr [Q_{em}(I_L^3 - \sin^2\theta_W Q_{em})] , \end{aligned} \quad (\text{A-2.46})$$

This parameter can be calculated by substituting the values of quark and lepton charges and weak isospins.

In the general case the value of the coefficient  $K$  is given by

$$K = \sum_i \left[ -\frac{(18 + 2n_i^2)\sin^2\theta_W}{9} \right] , \quad (\text{A-2.47})$$

where the sum is over the spinor chiralities, which appear as elementary fermions and  $n_i$  is the integer describing the coupling of the spinor field to the Kähler potential. The cross term vanishes provided the value of the Weinberg angle is given by

$$\sin^2\theta_W = \frac{9\sum_i 1}{(fg^2 + 2\sum_i(18 + n_i^2))} . \quad (\text{A-2.48})$$

In the scenario where both leptons and quarks are elementary fermions the value of the Weinberg angle is given by

$$\sin^2\theta_W = \frac{9}{(\frac{fg^2}{2} + 28)} . \quad (\text{A-2.49})$$

The bare value of the Weinberg angle is  $9/28$  in this scenario, which is not far from the typical value  $9/24$  of GUTs at high energies [B2]. The experimental value at the scale length scale of the electron can be deduced from the ratio of W and Z boson masses as  $\sin^2\theta_W = 1 - (m_W/m_Z)^2 \simeq .22290$ . This ratio and also the weak boson masses depend on the length scale.

If one interprets the additional term proportional to  $J$  as color action, one could perhaps interpret the value of Weinberg angle as expressing a connection between strong and weak coupling constant evolution. The limit  $f \rightarrow 0$  should correspond to an infinite value of color coupling strength and at this limit one would have  $\sin^2\theta_W = \frac{9}{28}$  for  $f/g^2 \rightarrow 0$ . This does not make sense since the Weinberg angle is in the standard model much smaller in QCD scale  $\Lambda$  corresponding roughly to pion mass scale. The Weinberg angle is in principle predicted by the p-adic coupling constant evolution fixed by the number theoretical vision of TGD.

One could however have a sum of electroweak action, correction terms changing the value of Weinberg angle, and color action and coupling constant evolution could be understood in terms of the coupling parameters involved.

### Electroweak symmetry breaking

One of the hardest challenges in the development of the TGD based view of weak symmetry breaking was the fact that classical field equations allow space-time surfaces with finite but arbitrarily large size. For a fixed space-time surface, the induced gauge fields, including classical weak fields, are long ranged. On the other hand, the large mass for weak bosons would require a short correlation length. How can one understand this together with the fact that a photon has a long correlation length?

In zero energy ontology quantum states are superpositions of space-time surfaces as analogs of almost unique Bohr orbits of particles identified as 3-D surfaces. For some reason the superposition should be such that the quantum averages of weak gauge boson fields vanish below the weak scale whereas the quantum average of electromagnetic fields is non-vanishing.

This is indeed the case.

1. The supersymplectic symmetries form isometries of the world of classical worlds (WCW) and they act in  $CP_2$  degrees of freedom as symplectic transformations leaving the  $CP_2$  symplectic form  $J$  invariant and therefore also its contribution to the electromagnetic field since this part is the same for all space-time surfaces in the superposition of space-time surfaces as a representation of supersymplectic isometry group (as a special case a representation of color group).
2. In TGD, color and electroweak symmetries acting as holonomies are not independent and for the  $SU(2)_L$  part of induced spinor connection the symplectic transformations induces  $SU(2)_L \times U(1)_R$  gauge transformation. This suggests that the quantum expectations of the induced weak fields over the space-time surfaces vanish above the quantum coherence scale. The averages of  $W$  and of the left handed part of  $Z^0$  should therefore vanish.
3.  $\langle Z^0 \rangle$  should vanish. For  $U(1)_R$  part of  $Z^0$ , the action of gauge transformation is trivial in gauge theory. Now however the space-time surface changes under symplectic transformations and this could make the average of the right-handed part of  $Z^0$  vanishing. The vanishing of the average of the axial part of the  $Z^0$  is suggested by the partially conserved axial current hypothesis.

One can formulate this picture quantitatively.

1. The electromagnetic field [L69] contains, besides the induced Kähler form, also the induced curvature form  $R_{12}$ , which couples vectorially. Conserved vector current hypothesis suggests that the average of  $R_{12}$  is non-vanishing. One can express the neutral part of the induced gauge field in terms of induced spinor curvature and Kähler form  $J$  as

$$\begin{aligned}
 R_{03} &= 2(2e^0 \wedge e^3 + e^1 \wedge e^2) = J + 2e^0 \wedge e^3 \quad , \\
 J &= 2(e^0 \wedge e^3 + e^1 \wedge e^2) \quad , \\
 R_{12} &= 2(e^0 \wedge e^3 + 2e^1 \wedge e^2) = 3J - 2e^0 \wedge e^3 \quad , 
 \end{aligned} \tag{A-2.50}$$

2. The induced fields  $\gamma$  and  $Z^0$  (photon and  $Z$ - boson) can be expressed as

$$\begin{aligned}
 \gamma &= 3J - \sin^2\theta_W R_{12} \quad , \\
 Z^0 &= 2R_{03} = 2(J + 2e^0 \wedge e^3) \tag{A-2.51} \\
 per. & \tag{A-2.52}
 \end{aligned}$$

The condition  $\langle Z^0 \rangle = 0$  gives  $2\langle e^0 \wedge e^3 \rangle = -2J$  and this in turn gives  $\langle R_{12} \rangle = 4J$ . The average over  $\gamma$  would be

$$\langle \gamma \rangle = (3 - 4\sin^2\theta_W)J \quad .$$

For  $\sin^2\theta_W = 3/4$   $\langle \gamma \rangle$  would vanish.

The quantum averages of classical weak fields quite generally vanish. What about correlation functions?

1. One expects that the correlators of classical weak fields as color invariants, and perhaps even symplectic invariants, are non-vanishing below the Compton length since in this kind of situation the points in the correlation function belong to the same 3-surface representing particle, such as hadron.

2. The intuitive picture is that in longer length scales one has disjoint 3-surfaces with a size scale of Compton length. If the states associated with two disjoint 3-surfaces are separately color invariant there are no correlations in color degrees of freedom and correlators reduce to the products of expectations of classical weak fields and vanish. This could also hold when the 3-surfaces are connected by flux tube bonds.

Below the Compton length weak bosons would thus behave as correlated massless fields. The Compton lengths of weak bosons are proportional to the value of effective Planck constant  $h_{eff}$  and in living systems the Compton lengths are proposed to be even of the order of cell size. This would explain the mysterious chiral selection in living systems requiring large parity violation.

3. What about the averages and correlators of color gauge fields? Classical color gauge fields are proportional to the products of Hamiltonians of color isometries induced Kähler form and the expectations of color Hamiltonians give vanishing average above Compton length and therefore vanishing average. Correlators are non-vanishing below the hadron scale. Gluons do not propagate in long scales for the same reason as weak bosons. This is implied by color confinement, which has also classical description in the sense that 3-surfaces have necessarily a finite size.

A large value of  $h_{eff}$  allows colored states even in biological scales below the Compton length since in this kind of situation the points in the correlation function belong to the same 3-surface representing particle, such as dark hadron.

### Discrete symmetries

The treatment of discrete symmetries C, P, and T is based on the following requirements:

1. Symmetries must be realized as purely geometric transformations.
2. Transformation properties of the field variables should be essentially the same as in the conventional quantum field theories [B3].

The action of the reflection  $P$  on spinors of is given by

$$\Psi \rightarrow P\Psi = \gamma^0 \otimes \gamma^0 \Psi . \quad (\text{A-2.53})$$

in the representation of the gamma matrices for which  $\gamma^0$  is diagonal. It should be noticed that  $W$  and  $Z^0$  bosons break parity symmetry as they should since their charge matrices do not commute with the matrix of P.

The guess that a complex conjugation in  $CP_2$  is associated with T transformation of the physicist turns out to be correct. One can verify by a direct calculation that pure Dirac action is invariant under T realized according to

$$\begin{aligned} m^k &\rightarrow T(M^k) , \\ \xi^k &\rightarrow \bar{\xi}^k , \\ \Psi &\rightarrow \gamma^1 \gamma^3 \otimes 1 \Psi . \end{aligned} \quad (\text{A-2.54})$$

The operation bearing closest resemblance to the ordinary charge conjugation corresponds geometrically to complex conjugation in  $CP_2$ :

$$\begin{aligned} \xi^k &\rightarrow \bar{\xi}^k , \\ \Psi &\rightarrow \Psi^\dagger \gamma^2 \gamma^0 \otimes 1 . \end{aligned} \quad (\text{A-2.55})$$

As one might have expected symmetries CP and T are exact symmetries of the pure Dirac action.

### A-3 Induction procedure and many-sheeted space-time

Since the classical gauge fields are closely related in TGD framework, it is not possible to have space-time sheets carrying only single kind of gauge field. For instance, em fields are accompanied by  $Z^0$  fields for extremals of Kähler action.

Classical em fields are always accompanied by  $Z^0$  field and some components of color gauge field. For extremals having homologically non-trivial sphere as a  $CP_2$  projection em and  $Z^0$  fields are the only non-vanishing electroweak gauge fields. For homologically trivial sphere only  $W$  fields are non-vanishing. Color rotations does not affect the situation.

For vacuum extremals all electro-weak gauge fields are in general non-vanishing although the net gauge field has  $U(1)$  holonomy by 2-dimensionality of the  $CP_2$  projection. Color gauge field has  $U(1)$  holonomy for all space-time surfaces and quantum classical correspondence suggest a weak form of color confinement meaning that physical states correspond to color neutral members of color multiplets.

#### A-3.1 Induction procedure for gauge fields and spinor connection

Induction procedure for gauge potentials and spinor structure is a standard procedure of bundle theory. If one has embedding of some manifold to the base space of a bundle, the bundle structure can be induced so that it has as a base space the imbedded manifold, whose points have as fiber the fiber if embedding space at their image points. In the recent case the embedding of space-time surface to embedding space defines the induction procedure. The induced gauge potentials and gauge fields are projections of the spinor connection of the embedding space to the space-time surface (see <http://tgdtheory.fi/appfigures/induct.jpg>).

Induction procedure makes sense also for the spinor fields of embedding space and one obtains geometrization of both electroweak gauge potentials and of spinors. The new element is induction of gamma matrices which gives their projections at space-time surface.

As a matter fact, the induced gamma matrices cannot appear in the counterpart of massless Dirac equation. To achieve super-symmetry, Dirac action must be replaced with Kähler-Dirac action for which gamma matrices are contractions of the canonical momentum currents of Kähler action with embedding space gamma matrices. Induced gamma matrices in Dirac action would correspond to 4-volume as action.

**Fig. 9.** Induction of spinor connection and metric as projection to the space-time surface. <http://tgdtheory.fi/appfigures/induct.jpg>.

#### A-3.2 Induced gauge fields for space-times for which $CP_2$ projection is a geodesic sphere

If one requires that space-time surface is an extremal of Kähler action and has a 2-dimensional  $CP_2$  projection, only vacuum extremals and space-time surfaces for which  $CP_2$  projection is a geodesic sphere, are allowed. Homologically non-trivial geodesic sphere correspond to vanishing  $W$  fields and homologically non-trivial sphere to non-vanishing  $W$  fields but vanishing  $\gamma$  and  $Z^0$ . This can be verified by explicit examples.

$r = \infty$  surface gives rise to a homologically non-trivial geodesic sphere for which  $e_0$  and  $e_3$  vanish imply the vanishing of  $W$  field. For space-time sheets for which  $CP_2$  projection is  $r = \infty$  homologically non-trivial geodesic sphere of  $CP_2$  one has

$$\gamma = \left(\frac{3}{4} - \frac{\sin^2(\theta_W)}{2}\right)Z^0 \simeq \frac{5Z^0}{8} .$$

The induced  $W$  fields vanish in this case and they vanish also for all geodesic sphere obtained by  $SU(3)$  rotation.

$Im(\xi^1) = Im(\xi^2) = 0$  corresponds to homologically trivial geodesic sphere. A more general representative is obtained by using for the phase angles of standard complex  $CP_2$  coordinates constant values. In this case  $e^1$  and  $e^3$  vanish so that the induced em,  $Z^0$ , and Kähler fields vanish but induced  $W$  fields are non-vanishing. This holds also for surfaces obtained by color rotation. Hence one can say that for non-vacuum extremals with 2-D  $CP_2$  projection color rotations and weak symmetries commute.

### A-3.3 Many-sheeted space-time

TGD space-time is many-sheeted: in other words, there are in general several space-sheets which have projection to the same  $M^4$  region. Second manner to say this is that  $CP_2$  coordinates are many-valued functions of  $M^4$  coordinates. The original physical interpretation of many-sheeted space-time was not correct: it was assumed that single sheet corresponds to GRT space-time and this obviously leads to difficulties since the induced gauge fields are expressible in terms of only four embedding space coordinates.

**Fig. 10.** Illustration of many-sheeted space-time of TGD. <http://tgdtheory.fi/appfigures/manysheeted.jpg>

#### Superposition of effects instead of superposition of fields

The first objection against TGD is that superposition is not possible for induced gauge fields and induced metric. The resolution of the problem is that it is effects which need to superpose, not the fields.

Test particle topologically condenses simultaneously to all space-time sheets having a projection to same region of  $M^4$  (that is touches them). The superposition of effects of fields at various space-time sheets replaces the superposition of fields. This is crucial for the understanding also how GRT space-time relates to TGD space-time, which is also in the appendix of this book).

#### Wormhole contacts

Wormhole contacts are key element of many-sheeted space-time. One does not expect them to be stable unless there is non-trivial Kähler magnetic flux flowing through them so that the throats look like Kähler magnetic monopoles.

**Fig. 11.** Wormhole contact. <http://tgdtheory.fi/appfigures/wormholecontact.jpg>

Since the flow lines of Kähler magnetic field must be closed this requires the presence of another wormhole contact so that one obtains closed monopole flux tube decomposing to two Minkowskian pieces at the two space-time sheets involved and two wormhole contacts with Euclidian signature of the induced metric. These objects are identified as space-time correlates of elementary particles and are clearly analogous to string like objects.

#### The relationship between the many-sheeted space-time of TGD and of GRT space-time

The space-time of general relativity is single-sheeted and there is no need to regard it as surface in  $H$  although the assumption about representability as vacuum extremal gives very powerful constraints in cosmology and astrophysics and might make sense in simple situations.

The space-time of GRT can be regarded as a long length scale approximation obtained by lumping together the sheets of the many-sheeted space-time to a region of  $M^4$  and providing it with an effective metric obtained as sum of  $M^4$  metric and deviations of the induced metrics of various space-time sheets from  $M^4$  metric. Also induced gauge potentials sum up in the similar manner so that also the gauge fields of gauge theories would not be fundamental fields.

**Fig. 12.** The superposition of fields is replaced with the superposition of their effects in many-sheeted space-time. <http://tgdtheory.fi/appfigures/fieldsuperpose.jpg>

Space-time surfaces of TGD are considerably simpler objects than the space-times of general relativity and relate to GRT space-time like elementary particles to systems of condensed matter physics. Same can be said about fields since all fields are expressible in terms of embedding space coordinates and their gradients, and general coordinate invariance means that the number of bosonic field degrees is reduced locally to 4. TGD space-time can be said to be a microscopic description whereas GRT space-time a macroscopic description. In TGD complexity of space-time topology replaces the complexity due to large number of fields in quantum field theory.

#### Topological field quantization and the notion of magnetic body

Topological field quantization also TGD from Maxwell's theory. TGD predicts topological light rays ("massless extremals (MEs)") as space-time sheets carrying waves or arbitrary shape propagating

with maximal signal velocity in single direction only and analogous to laser beams and carrying light-like gauge currents in the general case. There are also magnetic flux quanta and electric flux quanta. The deformations of cosmic strings with 2-D string orbit as  $M^4$  projection gives rise to magnetic flux tubes carrying monopole flux made possible by  $CP_2$  topology allowing homological Kähler magnetic monopoles.

**Fig. 13.** Topological quantization for magnetic fields replaces magnetic fields with bundles of them defining flux tubes as topological field quanta. <http://tgdtheory.fi/appfigures/field.jpg>

The imbeddability condition for say magnetic field means that the region containing constant magnetic field splits into flux quanta, say tubes and sheets carrying constant magnetic field. Unless one assumes a separate boundary term in Kähler action, boundaries in the usual sense are forbidden except as ends of space-time surfaces at the boundaries of causal diamonds. One obtains typically pairs of sheets glued together along their boundaries giving rise to flux tubes with closed cross section possibly carrying monopole flux.

These kind of flux tubes might make possible magnetic fields in cosmic scales already during primordial period of cosmology since no currents are needed to generate these magnetic fields: cosmic string would be indeed this kind of objects and would be dominated during the primordial period. Even superconductors and maybe even ferromagnets could involve this kind of monopole flux tubes.

### A-3.4 Embedding space spinors and induced spinors

One can geometrize also fermionic degrees of freedom by inducing the spinor structure of  $M^4 \times CP_2$ .

$CP_2$  does not allow spinor structure in the ordinary sense but one can couple the opposite  $H$ -chiralities of  $H$ -spinors to an  $n = 1$  ( $n = 3$ ) integer multiple of Kähler gauge potential to obtain a respectable modified spinor structure. The em charges of resulting spinors are fractional (integer valued) and the interpretation as quarks (leptons) makes sense since the couplings to the induced spinor connection having interpretation in terms electro-weak gauge potential are identical to those assumed in standard model.

The notion of quark color differs from that of standard model.

1. Spinors do not couple to color gauge potential although the identification of color gauge potential as projection of  $SU(3)$  Killing vector fields is possible. This coupling must emerge only at the effective gauge theory limit of TGD.
2. Spinor harmonics of embedding space correspond to triality  $t = 1$  ( $t = 0$ ) partial waves. The detailed correspondence between color and electroweak quantum numbers is however not correct as such and the interpretation of spinor harmonics of embedding space is as representations for ground states of super-conformal representations. The wormhole pairs associated with physical quarks and leptons must carry also neutrino pair to neutralize weak quantum numbers above the length scale of flux tube (weak scale or Compton length). The total color quantum numbers of these states must be those of standard model. For instance, the color quantum numbers of fundamental left-hand neutrino and lepton can compensate each other for the physical lepton. For fundamental quark-lepton pair they could sum up to those of physical quark.

The well-definedness of em charge is crucial condition.

1. Although the embedding space spinor connection carries  $W$  gauge potentials one can say that the embedding space spinor modes have well-defined em charge. One expects that this is true for induced spinor fields inside wormhole contacts with 4-D  $CP_2$  projection and Euclidian signature of the induced metric.
2. The situation is not the same for the modes of induced spinor fields inside Minkowskian region and one must require that the  $CP_2$  projection of the regions carrying induced spinor field is such that the induced  $W$  fields and above weak scale also the induced  $Z^0$  fields vanish in order to avoid large parity breaking effects. This condition forces the  $CP_2$  projection to be 2-dimensional. For a generic Minkowskian space-time region this is achieved only if the



spinor modes are localized at 2-D surfaces of space-time surface - string world sheets and possibly also partonic 2-surfaces.

3. Also the Kähler-Dirac gamma matrices appearing in the modified Dirac equation must vanish in the directions normal to the 2-D surface in order that Kähler-Dirac equation can be satisfied. This does not seem plausible for space-time regions with 4-D  $CP_2$  projection.
4. One can thus say that strings emerge from TGD in Minkowskian space-time regions. In particular, elementary particles are accompanied by a pair of fermionic strings at the opposite space-time sheets and connecting wormhole contacts. Quite generally, fundamental fermions would propagate at the boundaries of string world sheets as massless particles and wormhole contacts would define the stringy vertices of generalized Feynman diagrams. One obtains geometrized diagrammatics, which brings looks like a combination of stringy and Feynman diagrammatics.
5. This is what happens in the the generic situation. Cosmic strings could serve as examples about surfaces with 2-D  $CP_2$  projection and carrying only em fields and allowing delocalization of spinor modes to the entire space-time surfaces.

### A-3.5 About induced gauge fields

In the following the induced gauge fields are studied for general space-time surface without assuming the preferred extremal property (Bohr orbit property). Therefore the following arguments are somewhat obsolete in their generality.

#### Space-times with vanishing em, $Z^0$ , or Kähler fields

The following considerations apply to a more general situation in which the homologically trivial geodesic sphere and extremal property are not assumed. It must be emphasized that this case is possible in TGD framework only for a vanishing Kähler field.

Using spherical coordinates  $(r, \Theta, \Psi, \Phi)$  for  $CP_2$ , the expression of Kähler form reads as

$$\begin{aligned} J &= \frac{r}{F^2} dr \wedge (d\Psi + \cos(\Theta)d\Phi) + \frac{r^2}{2F} \sin(\Theta)d\Theta \wedge d\Phi , \\ F &= 1 + r^2 . \end{aligned} \tag{A-3.1}$$

The general expression of electromagnetic field reads as

$$\begin{aligned} F_{em} &= (3 + 2p) \frac{r}{F^2} dr \wedge (d\Psi + \cos(\Theta)d\Phi) + (3 + p) \frac{r^2}{2F} \sin(\Theta)d\Theta \wedge d\Phi , \\ p &= \sin^2(\Theta_W) , \end{aligned} \tag{A-3.2}$$

where  $\Theta_W$  denotes Weinberg angle.

1. The vanishing of the electromagnetic fields is guaranteed, when the conditions

$$\begin{aligned} \Psi &= k\Phi , \\ (3 + 2p) \frac{1}{r^2 F} (d(r^2)/d\Theta)(k + \cos(\Theta)) + (3 + p) \sin(\Theta) &= 0 , \end{aligned} \tag{A-3.3}$$

hold true. The conditions imply that  $CP_2$  projection of the electromagnetically neutral space-time is 2-dimensional. Solving the differential equation one obtains

$$\begin{aligned}
r &= \sqrt{\frac{X}{1-X}} , \\
X &= D \left[ \frac{k+u}{C} \right]^\epsilon , \\
u &\equiv \cos(\Theta) , \quad C = k + \cos(\Theta_0) , \quad D = \frac{r_0^2}{1+r_0^2} , \quad \epsilon = \frac{3+p}{3+2p} ,
\end{aligned} \tag{A-3.4}$$

where  $C$  and  $D$  are integration constants.  $0 \leq X \leq 1$  is required by the reality of  $r$ .  $r = 0$  would correspond to  $X = 0$  giving  $u = -k$  achieved only for  $|k| \leq 1$  and  $r = \infty$  to  $X = 1$  giving  $|u+k| = [(1+r_0^2)/r_0^2]^{(3+2p)/(3+p)}$  achieved only for

$$\text{sign}(u+k) \times \left[ \frac{1+r_0^2}{r_0^2} \right]^{\frac{3+2p}{3+p}} \leq k+1 ,$$

where  $\text{sign}(x)$  denotes the sign of  $x$ .

The expressions for Kähler form and  $Z^0$  field are given by

$$\begin{aligned}
J &= -\frac{p}{3+2p} X du \wedge d\Phi , \\
Z^0 &= -\frac{6}{p} J .
\end{aligned} \tag{A-3.5}$$

The components of the electromagnetic field generated by varying vacuum parameters are proportional to the components of the Kähler field: in particular, the magnetic field is parallel to the Kähler magnetic field. The generation of a long range  $Z^0$  vacuum field is a purely TGD based feature not encountered in the standard gauge theories.

2. The vanishing of  $Z^0$  fields is achieved by the replacement of the parameter  $\epsilon$  with  $\epsilon = 1/2$  as becomes clear by considering the condition stating that  $Z^0$  field vanishes identically. Also the relationship  $F_{em} = 3J = -\frac{3}{4} \frac{r^2}{F} du \wedge d\Phi$  is useful.
3. The vanishing Kähler field corresponds to  $\epsilon = 1, p = 0$  in the formula for em neutral space-times. In this case classical em and  $Z^0$  fields are proportional to each other:

$$\begin{aligned}
Z^0 &= 2e^0 \wedge e^3 = \frac{r}{F^2} (k+u) \frac{\partial r}{\partial u} du \wedge d\Phi = (k+u) du \wedge d\Phi , \\
r &= \sqrt{\frac{X}{1-X}} , \quad X = D|k+u| , \\
\gamma &= -\frac{p}{2} Z^0 .
\end{aligned} \tag{A-3.6}$$

For a vanishing value of Weinberg angle ( $p = 0$ ) em field vanishes and only  $Z^0$  field remains as a long range gauge field. Vacuum extremals for which long range  $Z^0$  field vanishes but em field is non-vanishing are not possible.

**The effective form of  $CP_2$  metric for surfaces with 2-dimensional  $CP_2$  projection**

The effective form of the  $CP_2$  metric for a space-time having vanishing  $em, Z^0$ , or Kähler field is of practical value in the case of vacuum extremals and is given by

$$\begin{aligned}
 ds_{eff}^2 &= (s_{rr}(\frac{dr}{d\Theta})^2 + s_{\Theta\Theta})d\Theta^2 + (s_{\Phi\Phi} + 2ks_{\Phi\Psi})d\Phi^2 = \frac{R^2}{4}[s_{\Theta\Theta}^{eff}d\Theta^2 + s_{\Phi\Phi}^{eff}d\Phi^2] , \\
 s_{\Theta\Theta}^{eff} &= X \times \left[ \frac{\epsilon^2(1-u^2)}{(k+u)^2} \times \frac{1}{1-X} + 1 - X \right] , \\
 s_{\Phi\Phi}^{eff} &= X \times [(1-X)(k+u)^2 + 1 - u^2] ,
 \end{aligned}
 \tag{A-3.7}$$

and is useful in the construction of vacuum embedding of, say Schwarzschild metric.

**Topological quantum numbers**

Space-times for which either  $em, Z^0$ , or Kähler field vanishes decompose into regions characterized by six vacuum parameters: two of these quantum numbers ( $\omega_1$  and  $\omega_2$ ) are frequency type parameters, two ( $k_1$  and  $k_2$ ) are wave vector like quantum numbers, two of the quantum numbers ( $n_1$  and  $n_2$ ) are integers. The parameters  $\omega_i$  and  $n_i$  will be referred as electric and magnetic quantum numbers. The existence of these quantum numbers is not a feature of these solutions alone but represents a much more general phenomenon differentiating in a clear cut manner between TGD and Maxwell's electrodynamics.

The simplest manner to avoid surface Kähler charges and discontinuities or infinities in the derivatives of  $CP_2$  coordinates on the common boundary of two neighboring regions with different vacuum quantum numbers is topological field quantization, 3-space decomposes into disjoint topological field quanta, 3-surfaces having outer boundaries with possibly macroscopic size.

Under rather general conditions the coordinates  $\Psi$  and  $\Phi$  can be written in the form

$$\begin{aligned}
 \Psi &= \omega_2 m^0 + k_2 m^3 + n_2 \phi + \text{Fourier expansion} , \\
 \Phi &= \omega_1 m^0 + k_1 m^3 + n_1 \phi + \text{Fourier expansion} .
 \end{aligned}
 \tag{A-3.8}$$

$m^0, m^3$  and  $\phi$  denote the coordinate variables of the cylindrical  $M^4$  coordinates) so that one has  $k = \omega_2/\omega_1 = n_2/n_1 = k_2/k_1$ . The regions of the space-time surface with given values of the vacuum parameters  $\omega_i, k_i$  and  $n_i$  and  $m$  and  $C$  are bounded by the surfaces at which space-time surface becomes ill-defined, say by  $r > 0$  or  $r < \infty$  surfaces.

The space-time surface decomposes into regions characterized by different values of the vacuum parameters  $r_0$  and  $\Theta_0$ . At  $r = \infty$  surfaces  $n_2, \omega_2$  and  $m$  can change since all values of  $\Psi$  correspond to the same point of  $CP_2$ : at  $r = 0$  surfaces also  $n_1$  and  $\omega_1$  can change since all values of  $\Phi$  correspond to same point of  $CP_2$ , too. If  $r = 0$  or  $r = \infty$  is not in the allowed range space-time surface develops a boundary.

This implies what might be called topological quantization since in general it is not possible to find a smooth global embedding for, say a constant magnetic field. Although global embedding exists it decomposes into regions with different values of the vacuum parameters and the coordinate  $u$  in general possesses discontinuous derivative at  $r = 0$  and  $r = \infty$  surfaces. A possible manner to avoid edges of space-time is to allow field quantization so that 3-space (and field) decomposes into disjoint quanta, which can be regarded as structurally stable units a 3-space (and of the gauge field). This doesn't exclude partial join along boundaries for neighboring field quanta provided some additional conditions guaranteeing the absence of edges are satisfied.

For instance, the vanishing of the electromagnetic fields implies that the condition

$$\Omega \equiv \frac{\omega_2}{n_2} - \frac{\omega_1}{n_1} = 0 ,
 \tag{A-3.9}$$

is satisfied. In particular, the ratio  $\omega_2/\omega_1$  is rational number for the electromagnetically neutral regions of space-time surface. The change of the parameter  $n_1$  and  $n_2$  ( $\omega_1$  and  $\omega_2$ ) in general generates magnetic field and therefore these integers will be referred to as magnetic (electric) quantum numbers.

## A-4 The relationship of TGD to QFT and string models

The recent view of the relationship of TGD to QFT and string models has developed slowly during years and it seems that in a certain sense TGD means a return to roots: instead of QFT like description involving path integral one would have wave mechanics for 3-surfaces.

### A-4.1 TGD as a generalization of wave mechanism obtained by replacing point-like particles with 3-surfaces

The first vision of TGD was as a generalization of quantum field theory (string models) obtained by replacing pointlike particles (strings) as fundamental objects with 3-surfaces.

The later work has revealed that TGD could be seen as a generalization of the wave mechanism based on the replacement of a point-like particle with 3-D surface. This is due to holography implied by general coordinate invariance. The definition of the metric of the "world of classical worlds" (WCW) must assign a unique or at least almost unique space-time surface to a given 3-surface. This 4-surface is analogous to Bohr orbit so that also Bohr orbitology becomes an exact part of quantum physics. The failure of strict determinism forces to replace 3-surfaces with 4-surfaces and this leads to zero energy ontology (ZEO) in which quantum states are superpositions of space-time surfaces [K42, K22, K81] [L58, L64].

**Fig. 5.** TGD replaces point-like particles with 3-surfaces. <http://tgdtheory.fi/appfigures/particletgd.jpg>

### A-4.2 Extension of superconformal invariance

The fact that light-like 3-surfaces are effectively metrically 2-dimensional and thus possess generalization of 2-dimensional conformal symmetries with light-like radial coordinate defining the analog of second complex coordinate suggests that this generalization could work and extend the super-conformal symmetries to their 4-D analogs.

The boundary  $\delta M_+^4 = S^2 \times R_+$  of 4-D light-cone  $M_+^4$  is also metrically 2-dimensional and allows extended conformal invariance. Also the group of isometries of light-cone boundary and of light-like 3-surfaces is infinite-dimensional since the conformal scalings of  $S^2$  can be compensated by  $S^2$ -local scaling of the light-like radial coordinate of  $R_+$ . These simple facts mean that 4-dimensional Minkowski space and 4-dimensional space-time surfaces are in a completely unique position as far as symmetries are considered.

In fact, this leads to a generalization of the Kac-Moody type symmetries of string models.  $\delta M_+^4 \times CP_2$  allows huge supersymplectic symmetries for which the radial light-like coordinate of  $\delta M_+^4$  plays the role of complex string coordinate in string models. These symmetries are assumed to act as isometries of WCW.

### A-4.3 String-like objects and strings

String like objects obtained as deformations of cosmic strings  $X^2 \times Y^2$ , where  $X^2$  is minimal surface in  $M^4$  and  $Y^2$  a holomorphic surface of  $CP_2$  are fundamental extremals of Kähler action having string world sheet as  $M^4$  projections. Cosmic strings dominate the primordial cosmology of the TGD Universe and the inflationary period corresponds to the transition to radiation dominated cosmology for which space-time sheets with 4-D  $M^4$  projection dominate.

Also genuine string-like objects emerge from TGD. The conditions that the em charge of modes of induces spinor fields is well-defined requires in the generic case the localization of the modes at 2-D surfaces -string world sheets and possibly also partonic 2-surfaces. This in Minkowskian space-time regions.

**Fig. 6.** Well-definedness of em charge forces the localization of induced spinor modes to 2-D surfaces in generic situations in Minkowskian regions of space-time surface. <http://tgdtheory.fi/appfigures/fermistring.jpg>

### A-4.4 TGD view of elementary particles

The TGD based view about elementary particles has two key aspects.

1. The space-time correlates of elementary particles are identified as pairs of wormhole contacts with Euclidean signature of metric and having 4-D  $CP_2$  projection. Their throats behave effectively as Kähler magnetic monopoles so that wormhole throats must be connected by Kähler magnetic flux tubes with monopole flux so that closed flux tubes are obtained.
2. At the level of  $H$  Fermion number is carried by the modes of the induced spinor field. In space-time regions with Minkowski signature the modes are localized at string world sheets connecting the wormhole contacts.

**Fig. 7.** TGD view about elementary particles. a) Particle orbit corresponds to a 4-D generalization of a world line or b) with its light-like 3-D boundary (holography). c) Particle world lines have Euclidean signature of the induced metric. d) They can be identified as wormhole contacts. e) The throats of wormhole contacts carry effective Kähler magnetic charges so that wormhole contacts must appear as pairs in order to obtain closed flux tubes. f) Wormhole contacts are accompanied by fermionic strings connecting the throats at the same sheet: the strings do not extend inside the wormhole contacts. <http://tgdtheory.fi/appfigures/elparticletgd.jpg>  
 Particle interactions involve both stringy and QFT aspects.

1. The boundaries of string world sheets correspond to fundamental fermions. This gives rise to massless propagator lines in generalized Feynman diagrammatics. One can speak of "long" string connecting wormhole contacts and having a hadronic string as a physical counterpart. Long strings should be distinguished from wormhole contacts which due to their superconformal invariance behave like "short" strings with length scale given by  $CP_2$  size, which is  $10^4$  times longer than Planck scale characterizing strings in string models.
2. Wormhole contact defines basic stringy interaction vertex for fermion-fermion scattering. The propagator is essentially the inverse of the superconformal scaling generator  $L_0$ . Wormhole contacts containing fermion and antifermion at its opposite throats behave like virtual bosons so that one has BFF type vertices typically.
3. In topological sense one has 3-vertices serving as generalizations of 3-vertices of Feynman diagrams. In these vertices 4-D "lines" of generalized Feynman diagrams meet along their 3-D ends. One obtains also the analogs of stringy diagrams but stringy vertices do not have the usual interpretation in terms of particle decays but in terms of propagation of particles along two different routes.

**Fig. 8.** a) TGD analogs of Feynman and string diagrammatics at the level of space-time topology. b) The 4-D analogs of both string diagrams and QFT diagrams appear but the interpretation of the analogs stringy diagrams is different. <http://tgdtheory.fi/appfigures/tgdgraphs.jpg>

## **A-5 About the selection of the action defining the Kähler function of the "world of classical worlds" (WCW)**

The proposal is that space-time surfaces correspond to preferred extremals of some action principle, being analogous to Bohr orbits, so that they are almost deterministic. The action for the preferred extremal would define the Kähler function of WCW [K42, K81].

How unique is the choice of the action defining WCW Kähler metric? The problem is that twistor lift strongly suggests the identification of the preferred extremals as 4-D surfaces having 4-D generalization of complex structure and that a large number of general coordinate invariant actions constructible in terms of the induced geometry have the same preferred extremals.

### **A-5.1 Could twistor lift fix the choice of the action uniquely?**

The twistor lift of TGD [L39] [L58, L59, L60] generalizes the notion of induction to the level of twistor fields and leads to a proposal that the action is obtained by dimensional reduction of the action having as its preferred extremals the counterpart of twistor space of the space-time surface identified as 6-D surface in the product  $T(M^4) \times T(CP_2)$  twistor spaces of  $T(M^4)$  and  $T(CP_2)$

of  $M^4$  and  $CP_2$ . Only  $M^4$  and  $CP_2$  allow a twistor space with Kähler structure [A12] so that TGD would be unique. Dimensional reduction is forced by the condition that the 6-surface has  $S^2$ -bundle structure characterizing twistor spaces and the base space would be the space-time surface.

1. Dimensional reduction of 6-D Kähler action implies that at the space-time level the fundamental action can be identified as the sum of Kähler action and volume term (cosmological constant). Other choices of the action do not look natural in this picture although they would have the same preferred extremals.
2. Preferred extremals are proposed to correspond to minimal surfaces with singularities such that they are also extremals of 4-D Kähler action outside the singularities. The physical analogue are soap films spanned by frames and one can localize the violation of the strict determinism and of strict holography to the frames.
3. The preferred extremal property is realized as the holomorphicity characterizing string world sheets, which generalizes to the 4-D situation. This in turn implies that the preferred extremals are the same for any general coordinate invariant action defined on the induced gauge fields and induced metric apart from possible extremals with vanishing  $CP_2$  Kähler action.

For instance, 4-D Kähler action and Weyl action as the sum of the tensor squares of the components of the Weyl tensor of  $CP_2$  representing quaternionic imaginary units constructed from the Weyl tensor of  $CP_2$  as an analog of gauge field would have the same preferred extremals and only the definition of Kähler function and therefore Kähler metric of WCW would change. One can even consider the possibility that the volume term in the 4-D action could be assigned to the tensor square of the induced metric representing a quaternionic or octonionic real unit.

Action principle does not seem to be unique. On the other hand, the WCW Kähler form and metric should be unique since its existence requires maximal isometries.

Unique action is not the only way to achieve this. One cannot exclude the possibility that the Kähler gauge potential of WCW in the complex coordinates of WCW differs only by a complex gradient of a holomorphic function for different actions so that they would give the same Kähler form for WCW. This gradient is induced by a symplectic transformation of WCW inducing a  $U(1)$  gauge transformation. The Kähler metric is the same if the symplectic transformation is an isometry.

Symplectic transformations of WCW could give rise to inequivalent representations of the theory in terms of action at space-time level. Maybe the length scale dependent coupling parameters of an effective action could be interpreted in terms of a choice of WCW Kähler function, which maximally simplifies the computations at a given scale.

1. The 6-D analogues of electroweak action and color action reducing to Kähler action in 4-D case exist. The 6-D analog of Weyl action based on the tensor representation of quaternionic imaginary units does not however exist. One could however consider the possibility that only the base space of twistor space  $T(M^4)$  and  $T(CP_2)$  have quaternionic structure.
2. Kähler action has a huge vacuum degeneracy, which clearly distinguishes it from other actions. The presence of the volume term removes this degeneracy. However, for minimal surfaces having  $CP_2$  projections, which are Lagrangian manifolds and therefore have a vanishing induced Kähler form, would be preferred extremals according to the proposed definition. For these 4-surfaces, the existence of the generalized complex structure is dubious.

For the electroweak action, the terms corresponding to charged weak bosons eliminate these extremals and one could argue that electroweak action or its sum with the analogue of color action, also proportional Kähler action, defines the more plausible choice. Interestingly, also the neutral part of electroweak action is proportional to Kähler action.

Twistor lift strongly suggests that also  $M^4$  has the analog of Kähler structure.  $M^8$  must be complexified by adding a commuting imaginary unit  $i$ . In the  $E^8$  subspace, the Kähler structure of  $E^4$  is defined in the standard sense and it is proposed that this generalizes to  $M^4$  allowing also

generalization of the quaternionic structure.  $M^4$  Kähler structure violates Lorentz invariance but could be realized at the level of moduli space of these structures.

The minimal possibility is that the  $M^4$  Kähler form vanishes: one can have a different representation of the Kähler gauge potential for it obtained as generalization of symplectic transformations acting non-trivially in  $M^4$ . The recent picture about the second quantization of spinors of  $M^4 \times CP_2$  assumes however non-trivial Kähler structure in  $M^4$ .

### A-5.2 Two paradoxes

TGD view leads to two apparent paradoxes.

1. If the preferred extremals satisfy 4-D generalization of holomorphicity, a very large set of actions gives rise to the same preferred extremals unless there are some additional conditions restricting the number of preferred extremals for a given action.
2. WCW metric has an infinite number of zero modes, which appear as parameters of the metric but do not contribute to the line element. The induced Kähler form depends on these degrees of freedom. The existence of the Kähler metric requires maximal isometries, which suggests that the Kähler metric is uniquely fixed apart from a conformal scaling factor  $\Omega$  depending on zero modes. This cannot be true: galaxy and elementary particle cannot correspond to the same Kähler metric.

Number theoretical vision and the hierarchy of inclusions of HFFs associated with supersymplectic algebra acting as isometries of WCW provide equivalent realizations of the measurement resolution. This solves these paradoxes and predicts that WCW decomposes into sectors for which Kähler metrics of WCW differ in a natural way.

### The hierarchy subalgebras of supersymplectic algebra implies the decomposition of WCW into sectors with different actions

Supersymplectic algebra of  $\delta M_+^4 \times CP_2$  is assumed to act as isometries of WCW [L64]. There are also other important algebras but these will not be discussed now.

1. The symplectic algebra  $A$  of  $\delta M_+^4 \times CP_2$  has the structure of a conformal algebra in the sense that the radial conformal weights with non-negative real part, which is half integer, label the elements of the algebra have an interpretation as conformal weights.

The super symplectic algebra  $A$  has an infinite hierarchy of sub-algebras [L64] such that the conformal weights of sub-algebras  $A_{n(SS)}$  are integer multiples of the conformal weights of the entire algebra. The superconformal gauge conditions are weakened. Only the subalgebra  $A_{n(SS)}$  and the commutator  $[A_{n(SS)}, A]$  annihilate the physical states. Also the corresponding classical Noether charges vanish for allowed space-time surfaces.

This weakening makes sense also for ordinary superconformal algebras and associated Kac-Moody algebras. This hierarchy can be interpreted as a hierarchy symmetry breakings, meaning that sub-algebra  $A_{n(SS)}$  acts as genuine dynamical symmetries rather than mere gauge symmetries. It is natural to assume that the super-symplectic algebra  $A$  does not affect the coupling parameters of the action.

2. The generators of  $A$  correspond to the dynamical quantum degrees of freedom and leave the induced Kähler form invariant. They affect the induced space-time metric but this effect is gravitational and very small for Einsteinian space-time surfaces with 4-D  $M^4$  projection.

The number of dynamical degrees of freedom increases with  $n(SS)$ . Therefore WCW decomposes into sectors labelled by  $n(SS)$  with different numbers of dynamical degrees of freedom so that their Kähler metrics cannot be equivalent and cannot be related by a symplectic isometry. They can correspond to different actions.

### Number theoretic vision implies the decomposition of WCW into sectors with different actions

The number theoretic vision leads to the same conclusion as the hierarchy of HFFs. The number theoretic vision of TGD based on  $M^8 - H$  duality [L64] predicts a hierarchy with levels labelled by the degrees  $n(P)$  of rational polynomials  $P$  and corresponding extensions of rationals characterized by Galois groups and by ramified primes defining p-adic length scales.

These sequences allow us to imagine several discrete coupling constant evolutions realized at the level  $H$  in terms of action whose coupling parameters depend on the number theoretic parameters.

#### 1. Coupling constant evolution with respect to $n(P)$

The first coupling constant evolution would be with respect to  $n(P)$ .

1. The coupling constants characterizing action could depend on the degree  $n(P)$  of the polynomial defining the space-time region by  $M^8 - H$  duality. The complexity of the space-time surface would increase with  $n(P)$  and new degrees of freedom would emerge as the number of the rational coefficients of  $P$ .
2. This coupling constant evolution could naturally correspond to that assignable to the inclusion hierarchy of hyperfinite factors of type  $II_1$  (HFFs). I have indeed proposed [L64] that the degree  $n(P)$  equals to the number  $n(\text{braid})$  of braids assignable to HFF for which super symplectic algebra subalgebra  $A_{n(SS)}$  with radial conformal weights coming as  $n(SS)$ -multiples of those of entire algebra  $A$ . One would have  $n(P) = n(\text{braid}) = n(SS)$ . The number of dynamical degrees of freedom increases with  $n$  which just as it increases with  $n(P)$  and  $n(SS)$ .
3. The actions related to different values of  $n(P) = n(\text{braid}) = n(SS)$  cannot define the same Kähler metric since the number of allowed space-time surfaces depends on  $n(SS)$ .

WCW could decompose to sub-WCWs corresponding to different actions, a kind of theory space. These theories would not be equivalent. A possible interpretation would be as a hierarchy of effective field theories.

4. Hierarchies of composite polynomials define sequences of polynomials with increasing values of  $n(P)$  such that the order of a polynomial at a given level is divided by those at the lower levels. The proposal is that the inclusion sequences of extensions are realized at quantum level as inclusion hierarchies of hyperfinite factors of type  $II_1$ .

A given inclusion hierarchy corresponds to a sequence  $n(SS)_i$  such that  $n(SS)_i$  divides  $n(SS)_{i+1}$ . Therefore the degree of the composite polynomials increases very rapidly. The values of  $n(SS)_i$  can be chosen to be primes and these primes correspond to the degrees of so called prime polynomials [L61] so that the decompositions correspond to prime factorizations of integers. The "densest" sequence of this kind would come in powers of 2 as  $n(SS)_i = 2^i$ . The corresponding p-adic length scales (assignable to maximal ramified primes for given  $n(SS)_i$ ) are expected to increase roughly exponentially, say as  $2^{r2^i}$ .  $r = 1/2$  would give a subset of scales  $2^{r/2}$  allowed by the p-adic length scale hypothesis. These transitions would be very rare.

A theory corresponding to a given composite polynomial would contain as sub-theories the theories corresponding to lower polynomial composites. The evolution with respect to  $n(SS)$  would correspond to a sequence of phase transitions in which the action genuinely changes. For instance, color confinement could be seen as an example of this phase transition.

5. A subset of p-adic primes allowed by the p-adic length scale hypothesis  $p \simeq 2^k$  defining the proposed p-adic length scale hierarchy could relate to  $n_S$  changing phase transition. TGD suggests a hierarchy of hadron physics corresponding to a scale hierarchy defined by Mersenne primes and their Gaussian counterparts [K53, K54]. Each of them would be characterized by a confinement phase transition in which  $n_S$  and therefore also the action changes.



2. *Coupling constant evolutions with respect to ramified primes for a given value of  $n(P)$*

For a given value of  $n(P)$ , one could have coupling constant sub-evolutions with respect to the set of ramified primes of  $P$  and dimensions  $n = h_{eff}/h_0$  of algebraic extensions. The action would only change by  $U(1)$  gauge transformation induced by a symplectic isometry of WCW. Coupling parameters could change but the actions would be equivalent.

The choice of the action in an optimal manner in a given scale could be seen as a choice of the most appropriate effective field theory in which radiative corrections would be taken into account. One can interpret the possibility to use a single choice of coupling parameters in terms of quantum criticality.

The range of the p-adic length scales labelled by ramified primes and effective Planck constants  $h_{eff}/h_0$  is finite for a given value of  $n(SS)$ .

The first coupling constant evolution of this kind corresponds to ramified primes defining p-adic length scales for given  $n(SS)$ .

1. Ramified primes are factors of the discriminant  $D(P)$  of  $P$ , which is expressible as a product of non-vanishing root differents and reduces to a polynomial of the  $n$  coefficients of  $P$ . Ramified primes define p-adic length scales assignable to the particles in the amplitudes scattering amplitudes defined by zero energy states.

$P$  would represent the space-time surface defining an interaction region in  $N$ -particle scattering. The  $N$  ramified primes dividing  $D(P)$  would characterize the p-adic length scales assignable to these particles. If  $D(P)$  reduces to a single ramified prime, one has elementary particle [L61], and the forward scattering amplitude corresponds to the propagator.

This would give rise to a multi-scale p-adic length scale evolution of the amplitudes analogous to the ordinary continuous coupling constant evolution of n-point scattering amplitudes with respect to momentum scales of the particles. This kind of evolutions extend also to evolutions with respect to  $n(SS)$ .

2. According to [L61], physical constraints require that  $n(P)$  and the maximum size of the ramified prime of  $P$  correlate.

A given rational polynomial of degree  $n(P)$  can be always transformed to a polynomial with integer coefficients. If the integer coefficients are smaller than  $n(P)$ , there is an upper bound for the ramified primes. This assumption also implies that finite fields become fundamental number fields in number theoretical vision [L61].

3. p-Adic length scale hypothesis [L65] in its basic form states that there exist preferred primes  $p \simeq 2^k$  near some powers of 2. A more general hypothesis states that also primes near some powers of 3 possibly also other small primes are preferred physically. The challenge is to understand the origin of these preferred scales.

For polynomials  $P$  with a given degree  $n(P)$  for which discriminant  $D(P)$  is prime, there exists a maximal ramified prime. Numerical calculations suggest that the upper bound depends exponentially on  $n(P)$ .

Could these maximal ramified primes satisfy the p-adic length scale hypothesis or its generalization? The maximal prime defines a fixed point of coupling constant evolution in accordance with the earlier proposal. For instance, could one think that one has  $p \simeq 2^k$ ,  $k = n(SS)$ ? Each p-adic prime would correspond to a p-adic coupling constant sub-evolution representable in terms of symplectic isometries.

Also the dimension  $n$  of the algebraic extension associated with  $P$ , which is identified in terms of effective Planck constant  $h_{eff}/h_0 = n$  labelling different phases of the ordinary matter behaving like dark matter, could give rise to coupling constant evolution for given  $n(SS)$ . The range of allowed values of  $n$  is finite. Note however that several polynomials of a given degree can correspond to the same dimension of extension.

**Number theoretic discretization of WCW and maxima of WCW Kähler function**

Number theoretic approach involves a unique discretization of space-time surface and also of WCW. The question is how the points of the discretized WCW correspond to the preferred extremals.

1. The exponents of Kähler function for the maxima of Kähler function, which correspond to the universal preferred extremals, appear in the scattering amplitudes. The number theoretical approach involves a unique discretization of space-time surfaces defining the WCW coordinates of the space-time surface regarded as a point of WCW.

In [L64] it is assumed that these WCW points appearing in the number theoretical discretization correspond to the maxima of the Kähler function. The maxima would depend on the action and would differ for ghd maxima associated with different actions unless they are not related by symplectic WCW isometry.

2. The symplectic transformations of WCW acting as isometries are assumed to be induced by the symplectic transformations of  $\delta M_+^4 \times CP_2$  [K42, K22]. As isometries they would naturally permute the maxima with each other.

## A-6 Number theoretic vision of TGD

Physics as number theory vision is complementary to the physics as geometry vision and has developed gradually since 1993. Langlands program is the counterpart of this vision in mathematics [L63].

The notion of p-adic number fields emerged with the motivation coming from the observation that elementary particle mass scales and mass ratios could be understood in terms of the so-called p-adic length scale hypothesis [K58, K48, K20]. The fusion of the various p-adic physics leads to what I call adelic physics [L37, L38]. Later the hypothesis about hierarchy of Planck constants labelling phases of ordinary matter behaving like dark matter emerged [K23, K24, K25, K25].

Eventually this led to that the values of effective Planck constant could be identified as the dimension of an algebraic extension of rationals assignable to polynomials with rational coefficients. This led to the number theoretic vision in which so-called  $M^8 - H$  duality [L54, L55] plays a key role.  $M^8$  (actually a complexification of real  $M^8$ ) is analogous to momentum space so that the duality generalizes momentum position duality for point-like particles.  $M^8$  has an interpretation as complexified octonions.

The dynamics of 4-surfaces in  $M^8$  is coded by polynomials with rational coefficients, whose roots define mass shells  $H^3$  of  $M^4 \subset M^8$ . It has turned out that the polynomials satisfy stringent additional conditions and one can speak of number theoretic holography [L61, L63]. Also the ordinary  $3 \rightarrow 4$  holography is needed to assign 4-surfaces with these 3-D mass shells. The number theoretic dynamics is based on the condition that the normal space of the 4-surface in  $M^8$  is associative (quaternionic) and contains a commutative complex sub-space. This makes it possible to assign to this surface space-time surface in  $H = M^4 \times CP_2$ .

At the level of  $H$  the space-time surfaces are by holography preferred extremals and are assumed to be determined by the twistor lift of TGD [L39] giving rise to an action which is sum of the Kähler action and volume term. The preferred extremals would be minimal surfaces analogous to soap films spanned by frames. Outside frames they would be simultaneous extremals of the Kähler action, which requires a generalization of the holomorphy characterizing string world sheets.

In the following only p-adic numbers and hierarchy of Planck constants will be discussed.

### A-6.1 p-Adic numbers and TGD

#### p-Adic number fields

p-Adic numbers ( $p$  is prime: 2, 3, 5, ...) can be regarded as a completion of the rational numbers using a norm, which is different from the ordinary norm of real numbers [A5]. p-Adic numbers are representable as power expansion of the prime number  $p$  of form

$$x = \sum_{k \geq k_0} x(k)p^k, \quad x(k) = 0, \dots, p-1. \quad (\text{A-6.1})$$

The norm of a p-adic number is given by

$$|x| = p^{-k_0(x)} . \tag{A-6.2}$$

Here  $k_0(x)$  is the lowest power in the expansion of the p-adic number. The norm differs drastically from the norm of the ordinary real numbers since it depends on the lowest pinary digit of the p-adic number only. Arbitrarily high powers in the expansion are possible since the norm of the p-adic number is finite also for numbers, which are infinite with respect to the ordinary norm. A convenient representation for p-adic numbers is in the form

$$x = p^{k_0} \varepsilon(x) , \tag{A-6.3}$$

where  $\varepsilon(x) = k + \dots$  with  $0 < k < p$ , is p-adic number with unit norm and analogous to the phase factor  $\exp(i\phi)$  of a complex number.

The distance function  $d(x, y) = |x - y|_p$  defined by the p-adic norm possesses a very general property called ultra-metricity:

$$d(x, z) \leq \max\{d(x, y), d(y, z)\} . \tag{A-6.4}$$

The properties of the distance function make it possible to decompose  $R_p$  into a union of disjoint sets using the criterion that  $x$  and  $y$  belong to same class if the distance between  $x$  and  $y$  satisfies the condition

$$d(x, y) \leq D . \tag{A-6.5}$$

This division of the metric space into classes has following properties:

1. Distances between the members of two different classes  $X$  and  $Y$  do not depend on the choice of points  $x$  and  $y$  inside classes. One can therefore speak about distance function between classes.
2. Distances of points  $x$  and  $y$  inside single class are smaller than distances between different classes.
3. Classes form a hierarchical tree.

Notice that the concept of the ultra-metricity emerged in physics from the models for spin glasses and is believed to have also applications in biology [B9]. The emergence of p-adic topology as the topology of the effective space-time would make ultra-metricity property basic feature of physics.

**Canonical correspondence between p-adic and real numbers**

The basic challenge encountered by p-adic physicist is how to map the predictions of the p-adic physics to real numbers. p-Adic probabilities provide a basic example in this respect. Identification via common rationals and canonical identification and its variants have turned out to play a key role in this respect.

*1. Basic form of the canonical identification*

There exists a natural continuous map  $I : R_p \rightarrow R_+$  from p-adic numbers to non-negative real numbers given by the ‘‘pinary’’ expansion of the real number for  $x \in R$  and  $y \in R_p$  this correspondence reads

$$y = \sum_{k > N} y_k p^k \rightarrow x = \sum_{k < N} y_k p^{-k} ,$$

$$y_k \in \{0, 1, \dots, p - 1\} . \tag{A-6.6}$$

This map is continuous as one easily finds out. There is however a little difficulty associated with the definition of the inverse map since the pinary expansion like also decimal expansion is not unique ( $1 = 0.999\dots$ ) for the real numbers  $x$ , which allow pinary expansion with finite number of pinary digits

$$\begin{aligned} x &= \sum_{k=N_0}^N x_k p^{-k} , \\ x &= \sum_{k=N_0}^{N-1} x_k p^{-k} + (x_N - 1)p^{-N} + (p-1)p^{-N-1} \sum_{k=0,\dots} p^{-k} . \end{aligned} \tag{A-6.7}$$

The p-adic images associated with these expansions are different

$$\begin{aligned} y_1 &= \sum_{k=N_0}^N x_k p^k , \\ y_2 &= \sum_{k=N_0}^{N-1} x_k p^k + (x_N - 1)p^N + (p-1)p^{N+1} \sum_{k=0,\dots} p^k \\ &= y_1 + (x_N - 1)p^N - p^{N+1} , \end{aligned} \tag{A-6.8}$$

so that the inverse map is either two-valued for p-adic numbers having expansion with finite pinary digits or single valued and discontinuous and non-surjective if one makes pinary expansion unique by choosing the one with finite pinary digits. The finite pinary digit expansion is a natural choice since in the numerical work one always must use a pinary cutoff on the real axis.

## 2. The topology induced by canonical identification

The topology induced by the canonical identification in the set of positive real numbers differs from the ordinary topology. The difference is easily understood by interpreting the p-adic norm as a norm in the set of the real numbers. The norm is constant in each interval  $[p^k, p^{k+1})$  (see **Fig. A-6.1**) and is equal to the usual real norm at the points  $x = p^k$ : the usual linear norm is replaced with a piecewise constant norm. This means that p-adic topology is coarser than the usual real topology and the higher the value of  $p$  is, the coarser the resulting topology is above a given length scale. This hierarchical ordering of the p-adic topologies will be a central feature as far as the proposed applications of the p-adic numbers are considered.

Ordinary continuity implies p-adic continuity since the norm induced from the p-adic topology is rougher than the ordinary norm. p-Adic continuity implies ordinary continuity from right as is clear already from the properties of the p-adic norm (the graph of the norm is indeed continuous from right). This feature is one clear signature of the p-adic topology.

**Fig. 14.** The real norm induced by canonical identification from 2-adic norm. <http://tgdtheory.fi/appfigures/norm.png>

The linear structure of the p-adic numbers induces a corresponding structure in the set of the non-negative real numbers and p-adic linearity in general differs from the ordinary concept of linearity. For example, p-adic sum is equal to real sum only provided the summands have no common pinary digits. Furthermore, the condition  $x +_p y < \max\{x, y\}$  holds in general for the p-adic sum of the real numbers. p-Adic multiplication is equivalent with the ordinary multiplication only provided that either of the members of the product is power of  $p$ . Moreover one has  $x \times_p y < x \times y$  in general. The p-Adic negative  $-1_p$  associated with p-adic unit 1 is given by  $(-1)_p = \sum_k (p-1)p^k$  and defines p-adic negative for each real number  $x$ . An interesting possibility is that p-adic linearity might replace the ordinary linearity in some strongly nonlinear systems so these systems would look simple in the p-adic topology.

These results suggest that canonical identification is involved with some deeper mathematical structure. The following inequalities hold true:

$$\begin{aligned} (x + y)_R &\leq x_R + y_R , \\ |x|_p |y|_R \leq (xy)_R &\leq x_R y_R , \end{aligned} \tag{A-6.9}$$

where  $|x|_p$  denotes p-adic norm. These inequalities can be generalized to the case of  $(R_p)^n$  (a linear vector space over the p-adic numbers).

$$\begin{aligned} (x + y)_R &\leq x_R + y_R , \\ |\lambda|_p |y|_R \leq (\lambda y)_R &\leq \lambda_R y_R , \end{aligned} \tag{A-6.10}$$

where the norm of the vector  $x \in T_p^n$  is defined in some manner. The case of Euclidian space suggests the definition

$$(x_R)^2 = \left( \sum_n x_n^2 \right)_R . \tag{A-6.11}$$

These inequalities resemble those satisfied by the vector norm. The only difference is the failure of linearity in the sense that the norm of a scaled vector is not obtained by scaling the norm of the original vector. Ordinary situation prevails only if the scaling corresponds to a power of  $p$ .

These observations suggests that the concept of a normed space or Banach space might have a generalization and physically the generalization might apply to the description of some non-linear systems. The nonlinearity would be concentrated in the nonlinear behavior of the norm under scaling.

3. *Modified form of the canonical identification*

The original form of the canonical identification is continuous but does not respect symmetries even approximately. This led to a search of variants which would do better in this respect. The modification of the canonical identification applying to rationals only and given by

$$I_Q(q = p^k \times \frac{r}{s}) = p^k \times \frac{I(r)}{I(s)} \tag{A-6.12}$$

is uniquely defined for rationals, maps rationals to rationals, has also a symmetry under exchange of target and domain. This map reduces to a direct identification of rationals for  $0 \leq r < p$  and  $0 \leq s < p$ . It has turned out that it is this map which most naturally appears in the applications. The map is obviously continuous locally since p-adically small modifications of  $r$  and  $s$  mean small modifications of the real counterparts.

Canonical identification is in a key role in the successful predictions of the elementary particle masses. The predictions for the light elementary particle masses are within extreme accuracy same for  $I$  and  $I_Q$  but  $I_Q$  is theoretically preferred since the real probabilities obtained from p-adic ones by  $I_Q$  sum up to one in p-adic thermodynamics.

4. *Generalization of number concept and notion of embedding space*

TGD forces an extension of number concept: roughly a fusion of reals and various p-adic number fields along common rationals is in question. This induces a similar fusion of real and p-adic embedding spaces. Since finite p-adic numbers correspond always to non-negative reals  $n$ -dimensional space  $R^n$  must be covered by  $2^n$  copies of the p-adic variant  $R_p^n$  of  $R^n$  each of which projects to a copy of  $R_+^n$  (four quadrants in the case of plane). The common points of p-adic and real embedding spaces are rational points and most p-adic points are at real infinity.

Real numbers and various algebraic extensions of p-adic number fields are thus glued together along common rationals and also numbers in algebraic extension of rationals whose number belong to the algebraic extension of p-adic numbers. This gives rise to a book like structure with rationals and various algebraic extensions of rationals taking the role of the back of the book. Note that Neper number is exceptional in the sense that it is algebraic number in p-adic number field  $Q_p$  satisfying  $e^p \text{ mod } p = 1$ .

**Fig. 15.** Various number fields combine to form a book like structure. <http://tgdtheory.fi/appfigures/book.jpg>

For a given p-adic space-time sheet most points are literally infinite as real points and the projection to the real embedding space consists of a discrete set of rational points: the interpretation in terms of the unavoidable discreteness of the physical representations of cognition is natural. Purely local p-adic physics implies real p-adic fractality and thus long range correlations for the real space-time surfaces having enough common points with this projection.

p-Adic fractality means that  $M^4$  projections for the rational points of space-time surface  $X^4$  are related by a direct identification whereas  $CP_2$  coordinates of  $X^4$  at these points are related by  $I, I_Q$  or some of its variants implying long range correlates for  $CP_2$  coordinates. Since only a discrete set of points are related in this manner, both real and p-adic field equations can be satisfied and there are no problems with symmetries. p-Adic effective topology is expected to be a good approximation only within some length scale range which means infrared and UV cutoffs. Also multi-p-fractality is possible.

### The notion of p-adic manifold

The notion of p-adic manifold is needed in order to fuse real physics and various p-adic physics to a larger structure which suggests that real and p-adic number fields should be glued together along common rationals bringing in mind adeles. The notion is problematic because p-adic topology is totally disconnected implying that p-adic balls are either disjoint or nested so that ordinary definition of manifold using p-adic chart maps fails. A cure is suggested to be based on chart maps from p-adics to reals rather than to p-adics (see the appendix of the book)

The chart maps are interpreted as cognitive maps, “thought bubbles”.

**Fig. 16.** The basic idea between p-adic manifold. <http://tgdtheory.fi/appfigures/padmanifold.jpg>

There are some problems.

1. Canonical identification does not respect symmetries since it does not commute with second pinary cutoff so that only a discrete set of rational points is mapped to their real counterparts by chart map arithmetic operations which requires pinary cutoff below which chart map takes rationals to rationals so that commutativity with arithmetics and symmetries is achieved in finite resolution: above the cutoff canonical identification is used
2. Canonical identification is continuous but does not map smooth p-adic surfaces to smooth real surfaces requiring second pinary cutoff so that only a discrete set of rational points is mapped to their real counterparts by chart map requiring completion of the image to smooth preferred extremal of Kähler action so that chart map is not unique in accordance with finite measurement resolution
3. Canonical identification violates general coordinate invariance of chart map: (cognition-induced symmetry breaking) minimized if p-adic manifold structure is induced from that for p-adic embedding space with chart maps to real embedding space and assuming preferred coordinates made possible by isometries of embedding space: one however obtains several inequivalent p-adic manifold structures depending on the choice of coordinates: these cognitive representations are not equivalent.

### A-6.2 Hierarchy of Planck constants and dark matter hierarchy

Hierarchy of Planck constants was motivated by the “impossible” quantal effects of ELF em fields on vertebrate cyclotron energies  $E = hf = \hbar \times eB/m$  are above thermal energy is possible only if  $\hbar$  has value much larger than its standard value. Also Nottale’s finding that planetary orbits might be understood as Bohr orbits for a gigantic gravitational Planck constant.

Hierarchy of Planck constant would mean that the values of Planck constant come as integer multiples of ordinary Planck constant:  $h_{eff} = n \times h$ . The particles at magnetic flux tubes characterized by  $h_{eff}$  would correspond to dark matter which would be invisible in the sense that only particle with same value of  $h_{eff}$  appear in the same vertex of Feynman diagram.

Hierarchy of Planck constants would be due to the non-determinism of the Kähler action predicting huge vacuum degeneracy allowing all space-time surfaces which are sub-manifolds of any  $M^4 \times Y^2$ , where  $Y^2$  is Lagrangian sub-manifold of  $CP_2$ . For a given  $Y^2$  one obtains new manifolds  $Y^2$  by applying symplectic transformations of  $CP_2$ .

Non-determinism would mean that the 3-surface at the ends of causal diamond (CD) can be connected by several space-time surfaces carrying same conserved Kähler charges and having same values of Kähler action. Conformal symmetries defined by Kac-Moody algebra associated with the embedding space isometries could act as gauge transformations and respect the light-likeness property of partonic orbits at which the signature of the induced metric changes from Minkowskian to Euclidian (Minkowskian space-time region transforms to wormhole contact say). The number of conformal equivalence classes of these surfaces could be finite number  $n$  and define discrete physical degree of freedom and one would have  $h_{eff} = n \times h$ . This degeneracy would mean "second quantization" for the sheets of n-furcation: not only one but several sheets can be realized.

This relates also to quantum criticality postulated to be the basic characteristics of the dynamics of quantum TGD. Quantum criticalities would correspond to an infinite fractal hierarchy of broken conformal symmetries defined by sub-algebras of conformal algebra with conformal weights coming as integer multiples of  $n$ . This leads also to connections with quantum criticality and hierarchy of broken conformal symmetries, p-adicity, and negentropic entanglement which by consistency with standard quantum measurement theory would be described in terms of density matrix proportional  $n \times n$  identity matrix and being due to unitary entanglement coefficients (typical for quantum computing systems).

Formally the situation could be described by regarding space-time surfaces as surfaces in singular n-fold singular coverings of embedding space. A stronger assumption would be that they are expressible as products of  $n_1$ -fold covering of  $M^4$  and  $n_2$ -fold covering of  $CP_2$  meaning analogy with multi-sheeted Riemann surfaces and that  $M^4$  coordinates are  $n_1$ -valued functions and  $CP_2$  coordinates  $n_2$ -valued functions of space-time coordinates for  $n = n_1 \times n_2$ . These singular coverings of embedding space form a book like structure with singularities of the coverings localizable at the boundaries of causal diamonds defining the back of the book like structure.

**Fig. 17.** Hierarchy of Planck constants. <http://tgdtheory.fi/appfigures/planckhierarchy.jpg>

### A-6.3 $M^8 - H$ duality as it is towards the end of 2021

The view of  $M^8 - H$  duality (see Appendix ??) has changed considerably towards the end 2021 [L58] after the realization that this duality is the TGD counterpart of momentum position duality of wave mechanics, which is lost in QFTs. Therefore  $M^8$  and also space-time surface is analogous to momentum space. This forced us to give up the original simple identification of the points  $M^4 \subset M^4 \times E^4 = M^8$  and of  $M^4 \times CP_2$  so that it respects Uncertainty Principle (UP).

The first improved guess for the duality map was the replacement with the inversion  $p^k \rightarrow m^k = \hbar_{eff} p^k / p^2$  conforming in spirit with UP but turned out to be too naive.

The improved form [L58] of the  $M^8 - H$  duality map takes mass shells  $p^2 = m^2$  of  $M^4 \subset M^8$  to cds with size  $L(m) = \hbar_{eff} / m$  with a common center. The slicing by mass shells is mapped to a Russian doll like slicing by cds. Therefore would be no CDs in  $M^8$  contrary to what I believed first.

Quantum classical correspondence (QCC) inspires the proposal that the point  $p^k \in M^8$  is mapped to a geodesic line corresponding to momentum  $p^k$  starting from the common center of cds. Its intersection with the opposite boundary of cd with size  $L(m)$  defines the image point. This is not yet quite enough to satisfy UP but the additional details [L58] are not needed in the sequel.

The 6-D brane-like special solutions in  $M^8$  are of special interest in the TGD inspired theory of consciousness. They have an  $M^4$  projection which is  $E = E_n$  3-ball. Here  $E_n$  is a root of the real polynomial  $P$  defining  $X^4 \subset M_c^8$  ( $M^8$  is complexified to  $M_c^8$ ) as a "root" of its octonionic continuation [L54, L55].  $E_n$  has an interpretation as energy, which can be complex. The original interpretation was as moment of time. For this interpretation,  $M^8 - H$  duality would be a linear identification and these hyper planes would be mapped to hyperplanes in  $M^4 \subset H$ .

This motivated the term "very special moment in the life of self" for the image of the  $E = E_n$  section of  $X^4 \subset M^8$  [L51]. This notion does not make sense at the level  $M^8$  anymore.

The modified  $M^8 - H$  duality forces us to modify the original interpretation [L58]. The point  $(E_n, p = 0)$  is mapped  $(t_n = \hbar_{eff}/E_n, 0)$ . The momenta  $(E_n, p)$  in  $E = E_n$  plane are mapped to the boundary of cd and correspond to a continuous time interval at the boundary of CD: "very special moment" becomes a "very special time interval".

The quantum state however corresponds to a set of points corresponding to quark momenta, which belong to a cognitive representation and are therefore algebraic integers in the extension determined by the polynomial. These active points in  $E_n$  are mapped to a discrete set at the boundary of cd(m). A "very special moment" is replaced with a sequence of "very special moments".

So called Galois confinement [L56] forces the total momenta for bound states of quarks and antiquarks to be rational integers invariant under Galois group of extension of rationals determined by the polynomial  $P$  [L58]. These states correspond to states at boundaries of sub-CDs so that one obtains a hierarchy. Galois confinement provides a universal number theoretic mechanism for the formation of bound states.

## A-7 Zero energy ontology (ZEO)

ZEO is implied by the holography forced in the TGD framework by general coordinate invariance.

### A-7.1 Basic motivations and ideas of ZEO

The following gives a brief summary of ZEO [L53] [K113].

1. In ZEO quantum states are not 3-dimensional but superpositions of 4-dimensional deterministic time evolutions connecting ordinary initial 3-dimensional states. By holography they are equivalent to pairs of ordinary 3-D states identified as initial and final states of time evolution. One can say that in the TGD framework general coordinate invariance implies holography and the slight failure of its determinism in turn forces ZEO.

Quantum jumps replace this state with a new one: a superposition of deterministic time evolutions is replaced with a new superposition. Classical determinism of individual time evolution is not violated and this solves the basic paradox of quantum measurement theory. There are two kinds of quantum jumps: ordinary ("big") state function reductions (BSFRs) changing the arrow of time and "small" state function reductions (SSFRs) (weak measurements) preserving it and giving rise to the analog of Zeno effect [L53].

2. To avoid getting totally confused it is good to emphasize some aspects of ZEO.
  - (a) ZEO does not mean that physical states in the usual 3-D sense as snapshots of time evolution would have zero energy state pairs defining zero energy states as initial and final states have same conserved quantities such as energy. Conservation implies that one can adopt the conventions that the values of conserved quantities are opposite for these states so that their sum vanishes: one can think that incoming and outgoing particles come from geometric past and future is the picture used in quantum field theories.
  - (b) ZEO means two times: subjective time as sequence of quantum jumps and geometric time as space-time coordinate. These times are identifiable but are strongly correlated.
3. In BSFRs the arrow of time is changed and the time evolution in the final state occurs backwards with respect to the time of the external observer. BSFRs can occur in all scales since TGD predicts a hierarchy of effective Planck constants with arbitrarily large values. There is empirical support for BSFRs.
  - (a) The findings of Mineev et al [L49] in atomic scale can be explained by the same mechanism [L49]. In BSFR a final zero energy state as a superposition of classical deterministic time evolutions emerges and for an observer with a standard arrow of time looks like a superposition of deterministic smooth time evolutions leading to the final state. Interestingly, once this evolution has started, it cannot be stopped unless one changes



the stimulus signal inducing the evolution in which case the process does not lead to anywhere: the interpretation would be that BSFR back to the initial state occurs!

- (b) Libets' experiments about active aspects of consciousness [J19] can be understood. Subject person raises his finger and neural activity starts before the conscious decision to do so. In the physicalistic framework it is thought to lead to raising of the finger. The problem with the explanation is that the activity beginning .5 seconds earlier seems to be dissipation with a reversed arrow of time: from chaotic and disordered to ordered at around .15 seconds. ZEO explanation is that macroscopic quantum jump occurred and generated a signal proceeding backwards in time and generated neural activity and dissipated to randomness.
- (c) Earthquakes involve a strange anomaly: they are preceded by ELF radiation. One would expect that they generate ELF radiation. The identification as BSFR would explain the anomaly [L50]. In biology the reversal of the arrow of time would occur routinely and be a central element of biological self-organization, in particular self-organized quantum criticality (see [L52, L73]).

### A-7.2 Some implications of ZEO

ZEO has profound implications for understanding self-organization and self-organized quantum criticality in terms of dissipation with non-standard arrow of time looking like generation of structures [L52, L73]. ZEO could also allow understanding of what planned actions - like realizing the experiment under consideration - could be.

1. Second law in the standard sense does not favor - perhaps even not allow - realization of planned actions. ZEO forces a generalization of thermodynamics: dissipation with a non-standard arrow of time for a subsystem would look like self-organization and planned action and its realization.

Could most if not all planned action be like this - induced by BSFR in the geometric future and only apparently planned? There would be however the experience of planning and realizing induced by the signals from geometric future by a higher level in the hierarchy of conscious entities predicted by TGD! In long time scales we would be realizing our fates or wishes of higher level conscious entities rather than agents with completely free will.

2. The notion of magnetic body (MB) serving as a boss of ordinary matter would be central. MB carries dark matter as  $h_{eff} = nh_0$  phases of ordinary matter with  $n$  serving as a measure for algebraic complexity of extension of rationals as its dimension and defining a kind of universal IQ. There is a hierarchy of these phases and MBs labelled by extension of rationals and the value of  $n$ .

MBs would form a hierarchy of bosses - a realization for master slave hierarchy. Ordinary matter would be at the bottom and its coherent behavior would be induced from quantum coherence at higher levels. BSFR for higher level MB would give rise to what looks like planned actions and experienced as planned action at the lower levels of hierarchy. One could speak of planned actions inducing a cascade of planned actions in shorter time scales and eventually proceeding to atomic level.

## A-8 Some notions relevant to TGD inspired consciousness and quantum biology

Below some notions relevant to TGD inspired theory of consciousness and quantum biology.

### A-8.1 The notion of magnetic body

Topological field quantization inspires the notion of field body about which magnetic body is especially important example and plays key role in TGD inspired quantum biology and consciousness theory. This is a crucial departure from the Maxwellian view. Magnetic body brings in third level

to the description of living system as a system interacting strongly with environment. Magnetic body would serve as an intentional agent using biological body as a motor instrument and sensory receptor. EEG would communicate the information from biological body to magnetic body and Libet's findings from time delays of consciousness support this view.

The following pictures illustrate the notion of magnetic body and its dynamics relevant for quantum biology in TGD Universe.

**Fig. 18.** Magnetic body associated with dipole field. <http://tgdtheory.fi/appfigures/fluxquant.jpg>

**Fig. 19.** Illustration of the reconnection by magnetic flux loops. <http://tgdtheory.fi/appfigures/reconnect1.jpg>

**Fig. 20.** Illustration of the reconnection by flux tubes connecting pairs of molecules. <http://tgdtheory.fi/appfigures/reconnect2.jpg>

**Fig. 21.** Flux tube dynamics. a) Reconnection making possible magnetic body to "recognize" the presence of another magnetic body, b) braiding, knotting and linking of flux tubes making possible topological quantum computation, c) contraction of flux tube in phase transition reducing the value of  $h_{eff}$  allowing two molecules to find each other in dense molecular soup. <http://tgdtheory.fi/appfigures/fluxtubedynamics.jpg>

## A-8.2 Number theoretic entropy and negentropic entanglement

TGD inspired theory of consciousness relies heavily p-Adic norm allows an to define the notion of Shannon entropy for rational probabilities (and even those in algebraic extension of rationals) by replacing the argument of logarithm of probability with its p-adic norm. The resulting entropy can be negative and the interpretation is that number theoretic entanglement entropy defined by this formula for the p-adic prime minimizing its value serves as a measure for conscious information. This negentropy characterizes two-particle system and has nothing to do with the formal negative negentropy assignable to thermodynamic entropy characterizing single particle. Negentropy Maximization Principle (NMP) implies that number theoretic negentropy increases during evolution by quantum jumps. The condition that NMP is consistent with the standard quantum measurement theory requires that negentropic entanglement has a density matrix proportional to unit matrix so that in 2-particle case the entanglement matrix is unitary.

**Fig. 22.** Schrödinger cat is neither dead or alive. For negentropic entanglement this state would be stable. <http://tgdtheory.fi/appfigures/cat.jpg>

## A-8.3 Life as something residing in the intersection of reality and p-adicities

In TGD inspired theory of consciousness p-adic space-time sheets correspond to space-time correlates for thoughts and intentions. The intersections of real and p-adic preferred extremals consist of points whose coordinates are rational or belong to some extension of rational numbers in preferred embedding space coordinates. They would correspond to the intersection of reality and various p-adicities representing the "mind stuff" of Descartes. There is temptation to assign life to the intersection of realities and p-adicities. The discretization of the chart map assigning to real space-time surface its p-adic counterpart would reflect finite cognitive resolution.

At the level of "world of classical worlds" ( WCW ) the intersection of reality and various p-adicities would correspond to space-time surfaces (or possibly partonic 2-surfaces) representable in terms of rational functions with polynomial coefficients with are rational or belong to algebraic extension of rationals.

The quantum jump replacing real space-time sheet with p-adic one (vice versa) would correspond to a buildup of cognitive representation (realization of intentional action).

**Fig. 23.** The quantum jump replacing real space-time surface with corresponding p-adic manifold can be interpreted as formation of thought, cognitive representation. Its reversal

would correspond to a transformation of intention to action. <http://tgdtheory.fi/appfigures/padictoreal.jpg>

#### A-8.4 Sharing of mental images

The 3-surfaces serving as correlates for sub-selves can topologically condense to disjoint large space-time sheets representing selves. These 3-surfaces can also have flux tube connections and this makes possible entanglement of sub-selves, which unentangled in the resolution defined by the size of sub-selves. The interpretation for this negentropic entanglement would be in terms of sharing of mental images. This would mean that contents of consciousness are not completely private as assumed in neuroscience.

**Fig. 24.** Sharing of mental images by entanglement of subselves made possible by flux tube connections between topologically condensed space-time sheets associated with mental images. <http://tgdtheory.fi/appfigures/sharing.jpg>

#### A-8.5 Time mirror mechanism

Zero energy ontology (ZEO) is crucial part of both TGD and TGD inspired consciousness and leads to the understanding of the relationship between geometric time and experience time and how the arrow of psychological time emerges. One of the basic predictions is the possibility of negative energy signals propagating backwards in geometric time and having the property that entropy basically associated with subjective time grows in reversed direction of geometric time. Negative energy signals inspire time mirror mechanism (see **Fig. <http://tgdtheory.fi/appfigures/timemirror.jpg>** or **Fig. 24** in the appendix of this book) providing mechanisms of both memory recall, realization of intentional action initiating action already in geometric past, and remote metabolism. What happens that negative energy signal travels to past and is reflected as positive energy signal and returns to the sender. This process works also in the reverse time direction.

**Fig. 25.** Zero energy ontology allows time mirror mechanism as a mechanism of memory recall. Essentially “seeing” in time direction is in question. <http://tgdtheory.fi/appfigures/timemirror.jpg>

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