TGD view about water memory and the notion of morphogenetic field

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Abstract

Besides general problems, which might be regarded as philosophical, the anomalies of the physicalistic world view have served as the source of inspiration. Several poorly understood phenomena have played a central role in the "Poiroting-like" process leading to the development of TGD based views about quantum biology. Mention only the effects of ELF em fields on vertebrate brain, biophotons, water memory, Pollack effect, and Comorosan effect. The notion of syntropy by Fantappie, which challenges the belief that the arrow of time is not always the same in living systems, has been also inspiring.

In this article I will discuss the TGD based vision and the above listed phenomena, which are often forgotten. I will also compare the TGD based view with the proposed interpretation of morphogenetic field as em field generated by DNA and realizing genetic code discussed in the articles of Savelev et al, and compare it with the TGD based models of genetic code realized in terms of dark nucleons and dark photons. The findings described in these articles and in the articles of Yolene Thomas about water memory also provide new tests for the TGD based view. As always, this kind of process led to some new ideas and insights.

Contents

1 Introduction

This article was inspired by the proposal of Savelev et all published since 2019 that there exists what they call DNA resonance code [I30, I28, I29]. (see `https://cutt.ly/KAe6BOd`, `https://cutt.ly/rArqdlA`, and `https://cutt.ly/EArqzSL`).

1.1 Motivations for the introduction of morphogenetic field

Morphogenesis is one of the very poorly understood problems of biology. The mystery is how the genes can encode for the shape of the organism and guide the morphogenesis. It is extremely difficult to understand the coherence of living organisms in terms of mere biochemistry alone and the basic mechanisms of bio-catalysis are still poorly understood. Even taking into account electromagnetic fields, it is very difficult to understand how stochastic dynamics, which seems unavoidable in the standard physics, could explain morphogenesis.

This has motivated the introduction of the notion of morphogenetic field. Support for its existence and hints about its nature come from several unexplained findings made already by Gurwitch. Beloussov, Burkalov and many others continued the work of Gurwitch [I4] and produced evidence for the existence of the morphogenetic field.

Water memory is a strange phenomenon, which still induces highly emotional responses in the mainstream community although the basic objection has long ago become obsolete: if water forms representations of molecules the extreme dilution produces no problems. Benveniste and Montagnier [I10] involving the basic procedure used to produced homeopathic remedies have produced evidence that the morphogenetic field is electromagnetic and generated by DNA and interacting with it: the low frequency spectrum of the bio-active molecules can be even recorded and it creates

same biological effects as the real substance. The experiments also produce support for water memory and the basic method of homeopathy involving repeated dilutions and agitation plays a central role in the experiments. Montagnier has also produced evidence for the remote replication of DNA.

Also Peter Gariaev belongs to the pioneers and phantom DNA could have interpretation as a morphogenetic field: Gariaev talks about wave DNA [I6, I8, I17, I7]. I have written with Peter Gariaev an article about remote replication of DNA [K24].

Fröhlich condensates [J2, I14, I19] [J2] are analogous morphogenetic fields and would be generated by electric dipoles. They would explain the coherence of biosystems, which is very difficult to understand in the standard physics framework. No direct support for these fields has been found hitherto.

Miller and Webb [I22] proposed 2012 that the morphogenetic field is holographic and would be generated by DNA.

The authors of the articles [I30, I28, I29] that motivated this work, propose that morphogenetic field could be generated by DNA and might realize genetic code electromagnetically making it possible to transform the genetic information in terms of shape and form of the organism in morphogenesis.

1.2 The counterpart of morphogenetic field in the TGD framework

Quantum TGD brings in new physics elements crucial for TGD inspired quantum biology. The idea about p-adic physics as a description of correlates of cognition emerged around 1993. The systematic work with quantum biology and consciousness started around 1995 when I made also the first p-adic mass calculations. The first publication "Biological systems as quantum coherent systems" related to quantum biology appeared in CASYS2000 conference proceedings in 2020. During the first years of milleniums several ideas emerged, mention only the hierarchy of Planck constants as a possible explanation of dark matter, its number theoretical interpretation, and the notion of $M^8 - H$ duality.

This led gradually to what I call adelic physics. Adelic physics includes not only real numbers but also p-adic number fields and their extensions and was published 2017 [L12, L13] in a book by Springer. The notion of p-adic physics was originally inspired by the p-adic mass calculations and by the idea that p-adic number fields provide the correct language for the description of cognition. The requirement of number theoretical universality led to the realization that the hierarchy formed by extensions of rationals defines an evolutionary hierarchy behind the biological and other evolutionary hierarchies.

The articles published in the Journal of Non-locality and Remote Mental Interactions (2002-) and in Journal of Non-locality (2012-), both founded by Lian Sidoroff, give an idea about the evolution of TGD and TGD inspired quantum biology and consciousness theory. The articles published in journals founded by Huping Hu (2010-) give a view about the detailed evolution of ideas since 2010. In this article, as in all my articles and books about TGD, the references to TGD are to the updated versions of articles and books at my homepage.

Besides general problems, which might be regarded as philosophical, the anomalies of the physicalistic world view have served as the source of inspiration. Several poorly understood phenomena have played a central role in the "Poiroting-like" process leading to the development of TGD based views about quantum biology. Mention only the effects of ELF em fields on vertebrate brain [J1], biophotons [I23, I13], water memory [I33, I9, I11], Pollack effect [I15, I16, L5, I24, I35], and Comorosan effect [I27, I3]. The notion of syntropy by Fantappie [J3], which challenges the belief that the arrow of time is not always the same in living systems, has been also inspiring. Also the work of Rupert Sheldrake relating to morphic resonance [I25, I26] has been inspiring

In this article I will discuss the TGD based vision and the above listed phenomena, which are often forgotten. I have written during years several articles about morphogenesis from TGD point of view [L4, L8, L20, L9, L2] and I will compare the TGD based view with the proposed interpretation of morphogenetic field as em field generated by DNA and realizing genetic code discussed in the articles of Savelev et al [I30, I28, I29], and compare it with the TGD based models of genetic code realized in terms of dark nucleons and dark photons. The findings described in these articles and in the articles of Yolene Thomas [I33, I34] about water memory also provide new tests for the TGD based view. As always, this kind of process led to some new ideas and insights.

2 Basic ideas of TGD

In this secton I will describe briefly the basic ideas of TGD relevant to quantum biology, cognition and consciousness.

2.1 TGD view about space-time

1. The background comes from the new physics predicted by Topological GeometroDynamics (TGD). TGD emerged as a proposal for the unification of fundamental interactions [K1] and was based on the proposal that space-times are representable as 4-D surfaces in the 8-D space $H = M^4 \times CP_2$, the product of Minkowski space and complex projective space CP_2. TGD can be also regarded as a generalization of string models obtained by replacing 1-D strings in 10-D space with 3-surfaces in H and identifying the orbit of 3-surface as a space-time region.

2. The new view of space-time and 3-space brings the shape of 3-surface as a new degree of freedom. This also implies new topological degrees of freedom not possible in general relativity, where the condition that space-time is a small deformation of M^4 does not allow them. Even Euclidean signature of the induced metric is possible and realized for the space-time surfaces representing elementary particles. Geometrization of classical fields of standard model and quantum numbers emerges. The notion of field body (magnetic body) is of key importance in TGD inspired quantum biology.

3. Holography is one of the key notions of TGD and also central in the TGD based model of living matter. Holography in the sense that 3-D data determine the space-time surface as a preferred extremal analogous to Bohr orbit follows from general coordinate invariance in the TGD framework [K5, K11] [L40].

   One aspect of holography is the hologram like character of the space-time surface. Space-time as a conscious hologram is indeed the basic idea of TGD inspired theory of consciousness [K2]. Space-time sheets of the many-sheeted space-time located inside causal diamonds (CDs) form a hierarchy defining cognitive representations with a varying degree of accuracy and abstraction level. In the TGD framework, this translates to the p-adic length scale hierarchy and $h_{eff} = nh_0$ hierarchy of phases of ordinary matter behaving like dark matter and follows as a prediction of adelic physics [L12, L13].

2.2 Number theoretical vision

The concrete realization of adelic physics involves $M^8 - H$ duality as a basic building brick. $M^8 - H$ duality [L26, L27, L28] realizes evolutionary hierarchy number theoretically, justifies the hierarchy of dark matter as $h_{eff} = nh_0$ phases of ordinary matter, provides a detailed understanding of p-adic length scale hypothesis, and predicts Galois confinement as a universal mechanism for the formation of bound states. All these notions are central in the TGD inspired quantum biology.

2.2.1 $M^8 - H$ duality

One of the key discoveries was $M^8 - H$ duality, which states that geometrization of physics has as dual its number-theoretization.

1. The details of M^8H duality have developed slowly during years via several side tracks. In this view, space-times correspond to both 4-surfaces in H and in the complexification of M^8.

   At the level of M^8 they correspond to "roots" of polynomials P of real argument having rational coefficients and continued to polynomials with octonionic argument. Associativity as is the dynamical principle determining the 4-surfaces in M^8 and requires associative (quaternionic) normal space.

2. It took a long time to realize, or rather to admit, that the "roots" correspond to 3-D mass shells of $M^4 \subset M^8$ rather than 4-surfaces as the naive expectation was. 4-D surfaced X^4 in M^8 are defined by holography, which provides an alternative explicit definition of $M^8 - H$

duality, which associates with $X^4 \subset M^8$ a 4-D space-time surface in H. The image of X^4 is a minimal surface [L43] H with singularities, which is analogous to soap film with frames.

The space-time surface in H is a preferred extremal analogous to Bohr orbit, which means that, apart from singularities, it is a simultaneous extremal of both volume action and so called Kähler actio analogous to Maxwell action. This picture has a twistorial generalization and implies the twistor lift of TGD.

3. M^8 is analog of momentum space so that $M^8 - H$ duality, which maps the 4-surface in M^8 to space-time surfaces in H, can be seen as a generalization of momentum position duality of wave mechanics motivated by the replaced of point-like particles with 3-D surfaces. Cognitive representations as points of X^4 for which the momentum components are algebraic integers define a unique discretization of X^4. In the generic case their number is finite. At the mass shells $H^3 \subset M^4$ corresponding to the roots of P defining 3-D cross sections of X^4 the cognitive representation explode and can contain momenta with components which are algebraic integers and even rationals. One can say that intelligence as algebraic complexity is concentrated at 3-D mass shells and their images in H under $M^8 - H$ duality. This also explains why the world is experienced as 3-D.

4. Polynomial P with rational coefficients defines an extension of rationals partially characterized by its Galois group and by ramified primes appearing as divisors of the discriminant of the polynomial. The largests ramified prime is identified as the p-adic prime assignable to the space-time region. This notion emerged already around 1995 via p-adic mass calculations and the recent view gives justification for the p-adic thermodynamics and generalizes it to the level of scattering amplitudes. The functional composition of polynomials is an attractive general manner to build many-particle states at the level of M^8 and leads to very detailed proposal for the transition matrix [L44, L45]. It is also analogous to composition of functions, which plays a key role in computationalism. Nature would be a computationalist in a number-theoretically universal sense.

5. Number theoretical universality requires that the momenta of fundamental particles (actually quarks) as points of mass shells in $M^4 \subset M^8$ are algebraic integers. Periodic boundary conditions however imply Galois confinement as an analog of quark confinement. The conditions require that the physical states are Galois singlets: in particular, the momentum components are ordinary integers in the scale defined by the p-adic prime. This gives a a universal mechanism for the formation of bound states [L38, L40].

2.2.2 Dark matter as $h_{eff} = nh_0$ phases

Number theoretical vision provides a justification for several key notions of TGD based quantum biology and introduced before the recent understanding of M^8-H duality [L26, L27, L40, L44, L45].

1. Number theoretical vision leads to an identification of dark matter as phases of ordinary matter with Planck constant $h_{eff} = nh_0$, where n is the dimension of extension of rationals defined by P. h_{eff} can be much larger than h. This proposal emerged considerably earlier (around 2007) and was motivated by the strange effects of ELF radiation on the behavior and physiology of vertebrates [J1].

2. h_{eff} hierarchy makes quantum coherence possible in arbitrarily long scales and magnetic bodies (MBs) of the systems would carry dark matter in this sense. MB has an onion-like structure with layers labelled by h_{eff} and layers would form a master-slave hierarchy with ordinary biomatter at the bottom.

3. The value of h_{eff} depends on the character of interactions mediated by the flux tube. $h_{eff}/h < 100$ could be associated with valence bonds and hydrogen bonds [L10] and more generally to flux tubes mediating electromagnetic interactions.

   Nottale hypothesis [E1] introduces gravitational Planck constant $\hbar_{gr} = GMm/v_0$, where $v_0 < c$ has dimensions of velocity. In the TGD framework $\hbar_{gr}$ is interpreted as a genuine Planck constant and reflects dark matter, which corresponds to a high-dimensional extension

of rationals [K19, K17]. Note that the dimension of extension can be exponentially larger than the degree of the polynomial P: if the Galois group is the permutation group for roots, the dimension is $n!$.

The large value of h_{gr} conforms with the long range of gravitational interactions and predicts quantum gravity in arbitrarily long scales. The gravitational Compton length $\Lambda_{gr} = GM/v_0$ for a particle with mass m is independent of m and of the order of the Schwartzschild radius for mass M. Also cyclotron energy $E_c = \hbar_{gr}ZeB/m = GMZeB$ is independent of m. Both these features conform with the Equivalence Principle and are expected to play a crucial role in quantum biology [K18] [L16, L41].

2.3 Zero energy ontology

Zero energy ontology (ZEO) [K23] [L25, L36] is a further key notion of TGD and of TGD inspired biology and consciousness theory.

1. In ZEO quantum states as time= constant snapshot are replaced with a superposition of space-time surfaces as preferred extremals analogous to Bohr orbits.

   In biology and neuroscience functions and behaviors as precise time sequences are typical and have preferred extremals realized as a minimal 4-surface with singularities as space-time correlates. Genes would not code only 3-D structures but also their time evolutions, which would be dictated by 3-D initial values (3-surface) by Bohr orbit property.

   The motivation for the notion of morphogenetic field indeed is that biological processes look like computer programs or even better sequences of planned actions, rather than stochastic processes.

2. ZEO leads also to a new view about state function reduction (SFR) solving the basic problem of the standard quantum measurement theory. The basic prediction is that time reversal occurs in ordinary ("big") SFRs (BSFRs) but not in "small" SFRs (SSFRs) which replace the repeated measurement giving rise to the Zeno effect. The sequence of SSFRs correspond to the flow of consciousness for self as a conscious entity. Any un-entangled system can be regarded as self whose life corresponds to a sequence of SSFRs ending with BSFR changing the arrow of time and meaning reincarnation of self [L31, L32].

   The basic implication of ZEO is that BSFRs in even macroscopic scales for subsystems look like deterministic classical time evolutions for the observer with opposite arrow of time [L22] and Minev et al indeed observed this in atomic scales [L22]. No transition zone from quantum to classical is needed. For instance, there is evidence that earthquakes could be regarded as macroscopic BSFRs.

   This has also implications for the dynamics of DNA, in which time reversals might play a key role [L48, L49]. Quite generally, the phenomenon of quantum tunnelling could involve two sub-sequent BSFRs and tunnelling would correspond to a temporary change of the arrow of time [L40, L36].

3. The possibility of time reversal forces to generalize thermodynamics and leads to a generalization of second law. Time reversed subsystem obeys second law in reversed time directions and from the point of view of the system breaks it. This suggests a new mechanism of self-organization (in particular biological) as time reversed dissipation taking place spontaneously rather than as a result of intricate programming as in a computationalistic framework. This suggests a new view about homeosatasis [L50].

4. ZEO based theory of consciousness can be regarded as a generalization of quantum measurement theory based Negentropy Maximization Principle (NMP) [K6] [L35], which involves, besides ordinary entropy with matter, the p-adic entropies assigned with cognition which can be negative and tend to be so by NMP. The theory is consistent with the second law and explains the paradoxical looking findings of Jeremy England that biosystems seem to be maximal entropy producers.

2.4 Quantum criticality of TGD Universe

The notion of quantum criticality of TGD Universe was originally inspired by the question about how to make TGD unique if Kähler function $K(X^3)$ in WCW is defined by the Kähler action for a preferred extremal $X^4(X^3)$ assignable to a given 3-surface. Vacuum functional defined by the exponent of Kähler function is analogous to thermodynamical weight and the obvious idea with Kähler coupling strength taking the role of temperature. The obvious idea was that the value of Kähler coupling strength α_K is analogous to critical temperature so that TGD would be more or less uniquely defined. α_K is expected to have several values.

The precise meaning of quantum criticality is far from obvious. The recent progress in understanding the number theoretical aspects has however led to a considerable progress in this respect [L46].

1. The exponent $exp(-K)$ of Kähler function K is the action for the preferred extremal (PE) as a space-time surface in H. PE has 3-surfaces X^3 and Y^3 as its ends at the boundaries of causal diamond (CD= cd $\times CP_2$) of H.

2. Ideal holography would mean that Y^3 is fixed once Y^3 is known. PEs are however not completely deterministic but analogous to soap films with frames, which are known to allow non-determinism in the sense that frame does not define the soap film uniquely [L43, L46]. Hence X^3 does not fix Y^3 completely but there is a finite number of alternatives for given X^3.

3. X^3 at the passive boundary of CD corresponds to a maximum of K under variations of X^3 in accordance with its passive character. Note that the WCW metric has zero modes not appearing in the metric of WCW so that the maxima could correspond to different values of zero modes. These could define the analog of spin glass energy landscape. Also transitions tranforming zero modes to non-zero modes and vice versa are possible.

4. Y^3 at the active boundary of CD corresponds to a more general extremum of K with respect to variations of Y^3, a saddle point. This means criticality. The criticality corresponds to the classical non-determinism of preferred extremals. This leads to a vision about WCW homology as a generalization of Floer homology and characterizing the non-determism of the action [L46].

5. The sequence of SSFRs can be seen as a process leading from a saddle point towards maximum of K, somewhat analogous to the thermodynamical process leading to a thermal equilibrium as maximum of entropy. The non-determinism of SSFRs has as a correlate the classical determinism of preferred extremals.

It is now clear that the values of α_K is determined by the extension of rationals determined by polynomial P [L26, L27, L44, L45, L46].

1. Space-time region $X^4 \subset H$ is the image of a 4-surface of M^8 under $M^8 - H$ duality. The 4-surface in M^8 is determined by a polynomial P and by holography which actually defines the $M^8 - H$ duality explicitly.

2. The vacuum functional $exp(-K)$ for a maximum of K must be equal to number theoretical quantity associated with P. The most natural candidate is the discriminant D of P which is the product of squares of root differences for P: $exp(-K) = 1/D$. This condition predicts a spectrum of α_K appearing in K. p-Adic prime corresponds to the large primed dividing D.

3 Basic ideas of TGD inspired quantum biology and theory of consciousness

This section summarizes in more detail the ideas and concepts relevant for TGD inspired theory of consciousness and quantum biology.

3.1 Quantum criticality in biology

Quantum criticality [K16] has become key concept of quantum TGD and TGD inspired biology. Quantum criticality allows to understandard the hierarchy of Planck constants and also its relationship to p-adic length scale hypothesis, whose origin reduces to number theoretic vision about TGD [K22]. Dark matter phases characterized by $h_{eff} = n \times h$ accompany any quantum critical system, maybe even thermodynamimcally critical systems. The challenge is to find concrete realizations of quantum criticality in various scales. In biology biochemical realization is of special interest.

The basic aspect of quantum criticality is that the increase of h_{eff} occurs *spontaneously* since the process corresponds to increase of negentropy and NMP states that negentropic entanglement resources of the Universe are increasing as kind of Akashic records or cosmic library. At the level of selves this means that self "dies" and re-incarnates as its time reversal. Selves fight for survival and try to grow their negentropic resources to satisfy the requirements of NMP. This leads to metabolism and homeostasis characterizing living systems. The emergence of life would not be extremely rare accident but doomed to occur spontaneously sooner or later by basic law telling what happens in state function reduction in TGD Universe obeying Zero Energy Ontology (ZEO). Hence the process should occur spontaneously and increase h_{eff}.

1. The basic question is how quantum criticality is realized biochemically. Are the molecules excited near to a critical energy at which a dark ion at magnetic flux tube is generated and a phase transition analogous to that leading from ordinary to fourth phase of water occurs? Or are large systems near criticality to a generation of dark phase as the general vision about quantum criticality of TGD Universe suggests.

2. A natural assumption is that metabolic energy quantum should be able to induce the phase transition producing dark particles at criticality. Could dark photons in visible and UV range accompany criticality at the level of single molecule? Are cell membrane and neuronal membrane quantum critical systems and how they differ?

3. Dark variants of biologically important ions residing at magnetic flux tubes are in fundamental role in TGD inspired quantum biology. In particular, dark proton states are proposed to give rise to the dark analogs of DNA, RNA, amino-acids, and tRNA. The pairing of ordinary DNA/RNA/amino-acids with their dark analogs is expected to be fundamental in biology and transcription and translation are proposed to take place at dark level as the recent experimental findings indicate. How is this pairing realized? How ordinary DNA becomes paired with dark DNA or is it already paired with it?

3.2 MB carrying dark matter as controller of ordinary biomatter

MB contains dark matter identified, as phases of ordinary matter characterized by EQ with a dimension $n = h_{eff}/h_0$ serving as a measure of the algebraic complexity of a given space-time region [L26, L27], and interpreted as a universal IQ. The scales of quantum coherence increase with h_{eff}. The layers of MB characterized by the value of n naturally form a master-slave hierarchy in which ordinary matter with the smallest Planck constant is at the bottom, and controlled by higher levels. The energies of systems increase with h_{eff} and since h_{eff} tends to be spontaneously reduced, an energy feed is needed to preserve the distribution of h_{eff}: the interpretation is as an analog of a metabolic energy feed.

MB acts as a "boss" controlling ordinary matter and induces self-organization [L24].

3.2.1 Anatomy of MB

MB has, as its body parts, magnetic flux quanta: flux tubes and flux sheets. There are two kinds of flux quanta. Flux can be vanishing, which corresponds to a Maxwellian regime. Flux can also be non-vanishing and quantized corresponding to a monopole flux. In the monopole case, the magnetic field requires no current for its creation. This option is not possible in the Maxwellian world. By fractality of the TGD Universe, these flux tubes play a key role at all scales [L23].

Also the Earth's magnetic field with nominal value of $B_E = .5$ Gauss has two parts.

1. The monopole flux part (see **Fig. ??**) corresponds to the "endogenous" magnetic field $B_{end} = .2$ Gauss and explains the strange effects of ELF EM radiation on the physiology and behavior of vertebrates [J1].

   The presence of this part explains the stability of the Earth's magnetic field. This field should have decayed long ago in a Maxwellian world since it is generated by currents which disappear.The contribution of the molten iron in the Earth's core to B_E decays but the changes of the orientation of B_{end} regenerate it [L6]. Also, magnetic fields that penetrate super-conductors as quantized fluxes and even those of permanent magnets (as opposed to electromagnets) may have a monopole part consisting of flux quanta.

2. The interaction of MB with the gravitational field of Earth is discussed in [L42]. Intriguingly, the metabolic energy currency with the nominal value of .5 eV is rather close to the energy for the escape velocity of a proton. Could the transfer of ions from the surface of the Earth to MB be a standard process?

3.2.2 Evidence for dark charged particles

The notion of dark matter as a controller of biomatter preceded its justification based on number theory [L13, L12].

1. The values of $h_{eff} = nh_0$ must be so large that the energies $E = h_{eff}f$ of dark photons with EEG frequencies are in the biophoton energy range (visible and UV) assignable to molecular transitions [K10, K15].

2. What makes the large values of h_{eff} possible? Nottale's hypothesis [E1] introduces the notion of the gravitational Planck constant $\hbar_{gr} = GMm/v_0$, whose form is fixed by an Equivalence Principle (EP). In the TGD framework, $h_{eff} = h_{gr}$ is assigned to gravitational flux tubes [L16]. There are non-trivial implications that reflect EP.

   (a) The cyclotron energy spectrum $E_c = n\hbar_{gr}eB/m = nGMeB/v_0$ does not depend on the mass m of the charged particle and is thus universal. The energies involved are proposed to be in the range of biophoton energies (at least) suitable for control of the transitions of the bio-molecule. One cannot exclude lower energies above thermal energy for physiological temperature.

   (b) The gravitational binding energies of a mass m for Bohr orbits around M do not depend on M at all [L42].

Also relatively small values of h_{eff} are possible.

1. Electrons can also have dark phases, but now the value of h_{eff} would be much smaller and satisfy the generalized Nottale hypothesis $h_{eff} = h_{em}$, where h_{em} is the electromagnetic analogue of h_{gr} assignable to flux tubes accompanying valence bonds. This inspires a model of valence bonds [L10] predicting that the value of $h_{eff}/h_0 = n = h_{em}$ increases along the rows of the Periodic Table.

   This picture can explain why molecules such as proteins containing atoms towards the right end of the rows of the Periodic Table are ideal carriers of metabolic energy. It also explains why ions, such as Ca^{++} involved with the control and communications of the cell membrane with the "large" part of MB and having very large $h_{eff} = h_{gr}$, are towards the left end of the rows.

2. The energy scale of dark variants of valence electrons is proportional to $1/h_{eff}^2$ so that the orbital radii are scaled up and the identification as a Rydberg atom provides the only possibility in the standard physics model. Could dark valence electrons be in question? There is empirical evidence, known for decades, for the mysterious disappearance of valence electrons of some rare earth metals in heating. An article by Chatterjee et al [L11] discusses this phenomenon for Yb.

   The finding [D2] about "misbehaving" Ruthenium atoms also supports the view that covalent bonds involve dark valence electrons. Pairs of Ru atoms were expected to transform to Ru

dimers in thermo-dynamic equilibrium but this did not happen. This suggests that valence electrons associated with the valence bond of Ru dimers are dark in the TGD sense and the valence bonded Ru dimer has a higher energy than a pair of free Ru atoms.

TGD based explanation [L11] could be justified by a resonant coupling of dark electron with an ordinary Rydberg state of the valence electron. In the lowest approximation, dark valence electrons have energies in the spectrum of ordinary valence electrons so that a resonant coupling with Rydberg states can be considered. The evidence found by Randell Mill [D3] for atoms with an abnormally large scale of binding energy suggests the formula $h = 6h_0$ [L7]. Atomic binding energies are proportional to $1/h_{eff}^2$ and Mills reports that the binding energy scale can be 4 times larger than for ordinary atoms. This would correspond to $h_{eff} = h/2$.

3.2.3 Pollack effect

In the Pollack effect (PE) [I24] negatively charged exclusion zones (EZs) are induced at the boundary between the gel phase and water by an energy feed such as IR radiation. The negative charge of EZ is explained as a formation of flux tubes carrying dark protons, which are interpreted as dark nuclei. Every 4^{th} proton should transform to a dark proton transferred to the flux tubes to explain the observations.

A simple model for linear dark proton triplets predicts their states to be in a 1-1 correspondence with DNA, RNA, tRNA, and amino-acids and the numbers of codons coding for given amino-acid are predicted to be the same as for the vertebrate genetic code [L15, L21]. This suggests deep connections between nuclear physics and condensed matter physics, chemistry, and biology, which, in the reductionistic spirit, are considered separate disciplines.

EZs are able to remove impurities from their interior in conflict with the second law of thermodynamics (SL). The TGD based explanation is that the time reversal by BSFR at the level of MB [L25] also induces an effective time reversal in long time scales at the level of ordinary bio-matter.

PE explains the occurrence of a charge separation in living matter. DNA has one negative charge per nucleotide, microtubules are negatively charged, the cell is negatively charged, and ATP carries 3 units of negative charge. Therefore ZEO suggests that PE plays a key role in bio-control and macroscopic SFRs play a key role in living matter.

3.2.4 Basic differences between organic and in-organic matter

One of the basic differences between organic and in-organic matter would be the presence of dark protons and electrons.

1. The notions of acids and bases would reduce to the presence of dark protons: pH would characterize the fraction of dark protons. Reduction and oxidation (the REDOX reaction) could be understood in terms of a transfer of dark electrons associated with valence bonds [L53].

2. In biochemistry the density of dark protons would be much higher in PE [I15, I16, L5, I24, I35]. Dark ions could play a key role in TGD based view of biochemistry as the findings of Blackman and others suggest [J1].

3.2.5 Biocatalysis and water memory

Bio-catalysis and water memory [I31] remain mysteries in the bio-chemical approach. MB carrying dark matter could provide the needed mechanisms. Reconnection of flux tubes would be the basic mechanism of bio-catalysis and also explain water memory, which in the TGD framework forms the basis of the immune system [K4].

1. According to the TGD view of catalysis, tentacle-like U-shaped flux tubes associated with MBs of reactants reconnect to a pair of flux tubes connecting the molecules [L18]. This happens if there is a cyclotron resonance for dark cyclotron radiation assignable to massless extremals (MEs) associated with these "tentacles". This requires that the flux tubes have identical magnetic field strengths and - by flux quantization - the same thickness. The same

value of h_{eff} guarantees resonance. The next step is the shortening of the "tentacles" by a reduction of h_{eff} and the liberation of energy which "kicks" the reactants over the potential wall making an otherwise extremely slow process possible.

2. The physics of water is plagued by anomalies [I31]. TGD suggests an explanation [L14] in terms of flux tubes assignable to hydrogen bonds [L14, L19]. These flux tubes could have $h_{eff} > h$ so that these flux tube could be long and give rise to long range quantal correlations. Water could be seen as a many-phase system. MBs assignable to water molecule clusters could mimic the cyclotron frequency spectrum of the invader molecule and make possible water memory and a primitive immune system based on reconnections of the "tentacles" of a water cluster and invader molecule [L30]. In this framework water would represent a primitive life form.

3.2.6 Comorosan effect

Comorosan effect [I27, I3] demonstrates rather peculiar looking facts about the interaction of organic molecules with visible laser light at wavelength $\lambda = 546\ nm$, which corresponds to photon energy 2.27 eV. As a result of irradiation molecules seem to undergo a transition $S \to S^*$. S^* state has anomalously long lifetime and stability in solution. $S \to S^*$ transition has been detected through the interaction of S^* molecules with different biological macromolecules, like enzymes and cellular receptors. I have discussed Comorosan effect in [K9] but the discussion reflect the state of TGD for decades ago.

The typical result in the enzyme-substrate interaction is represented by the enhancement of the enzymic rate, when the respective enzyme substrate is previously irradiated for certain sharply defined times. These *efficient (irradiation) times* are enzyme dependent and can also depend on the biological origin of the enzyme.

The *intensity of laser light does not matter*. What is needed is that the intensity is above certain threshold. The original explanation in terms of saturation of effect (for large intensities of laser light the effect of laser light on organic molecules does not depend on the intensity) has turned to be unsatisfactory.

The effective times are always of the following type $t_i = i * 5$ sec, where i is certain integer. The general formula for the effective times is $t_k = t_m + (k-1)\tau_n$, $k = 1, 2, .., 6$, where t_m is the minimum radiation time inducing the first effect and τ_n is the period between two consecutive effects [I27, I3]. $t_m = m_E t_1$ and $\tau_n = n_E t_1$ are multiples of the basic time scale $t_1 = 5\ sec$: $t_k = (m_E + (k-1)n_E)t_1$. The integers m_E and n_E can be regarded as enzyme characteristics, depending however on the biological origin of the enzyme.

Consider the specific enzymic interaction $E + S \leftrightarrow ES \leftrightarrow E + P$, where E stands for enzyme, S for substrate and P interaction product. Assume that substrate S is subject to a sequence of distinct irradiations lasting for times $t_a, t_b, ...$ The following rules are found to hold true.

1. The irradiations of the substrate performed after an irradiation with efficient time have no effect on the enzyme-substrate interaction.

2. Any arbitrary irradiation of the substrate with irradiation time less than sixth efficient time t_6 performed prior to any other efficient time, is irrelevant for the enzyme-substrate interaction.

3. Any arbitrary irradiation of the substrate lasting more than the sixth efficient time t_6 and performed prior to an efficient time precludes all other subsequent effects in enzyme-substrate interaction.

4. Note that the time scales 5,10, 20 seconds have been observed in the clustering of RNA polymerase molecules [I5] discussed from TGD view point in [L17].

The work of Comorosan demonstrates that all irradiation times have nontrivial effect on organic molecules but that for effective times something very special must occur. One should understand what this "very special" is, derive Comorosan formula from a physical model and find a physical interpretation for the integers m_E and n_E appearing in the formula as well as explain the special role of $t > t_6$ irradiation times.

Comorosan effect suggests that communications to MB could take place even at the level of relatively simple biomolecules. One can get some grasp about the situation by considering simplest possible picture that one can imagine.

1. It seems that laser light keep care that a connection from the system MB is generated and preserved a critical time for the phase transition to take place. The phase transition itself could correspond to increase of h_{eff}. The problem is to understand why the intensity of laser light does not manner. This suggests that the flux tube can receive the energy of the laser light energy with some fixed rate depending on the enzyme. The receiver could be the MB of enzyme and that it has a dead time after the receival of quantum of laser light.

2. The proposal is that Josephson junctions are involved and the Josephson frequency $f_J = ZeV/h_{eff}$ defines the time scales in question.

3. The assumption $\hbar_{eff})/\hbar = \hbar_{gr}/\hbar = GMm/v_0 = 2r_s(E)m/v_0$, where $M = M_E$ is the mass of Earth, $r_s(E) = .09$ m and $m = 2m_e$ as mass of electron Cooper pair, m_e is electron mass, allows to estimate the parameter $\beta = v_0/c$ assuming $f_J = E_J/h_{gr}$ is equal to Comorosan frequency $f_C = 1/T_C = .2$ Hz. For Josephson energy $E_J = 2eV \simeq .1$ eV of electron Cooper pair, this gives the estimate $h_{gr}/h \simeq 5 \times 10^{13}$. The value of β_0 would be $\beta_0 \simeq .93$ near its maximal value. This estimate is consistent with the estimate of [L39].

4. There are two especially important cyclotron frequencies in endoenous magnetic field B_{end} with nominal value .2 Gauss.

   (a) The cyclotron energy $E_c = \hbar_{gr}ZeB_{end}/m$ of a charged particle does not depend on its mass. For Fe^{++} ion f_c in the endogenous magnetic field $B_{end} = 2B_E/5 = .2$ Gauss equals alpha frequency $f_c(Fe^{++}) = f_\alpha = 10$ Hz. Cyclotron energy $E_c(Fe^{++}) = h_{gr}f_c = 2.5$ eV. Note that this energy is not far from the energy 2.27 eV of photons in the experiments of Comorosan suggesting that they were in energy resonance with dark Josephson photons or were in energy resonance with them. For $\beta_0 = 1$, one would have $E_c(10Hz) = 2.44$ eV. For $E_c = 2.24$ eV one would obtain $\beta_0 = 1.024 \geq 1$. Scaling of 10 Hz alpha frequency to 9.3 Hz would allow $\beta_0 = 1$ and $E = 2.27$ eV.

   (b) DNA cyclotron frequency $f_J(DNA)$ is another probably very important frequency. It depends only weakly on DNA length and the base-pair it has has average value 1 Hz which corresponds to energy .244 eV. This is roughly 1/2 of the metabolic energy quantum.

   (c) To sum up, for $\beta_0 = 1$, one can relate to each other f_C, $f_J(Fe^{++}, B_{end})andf_J(DNA, B_{end})$, and the corresponding cycltron energies and the value of the membrane potential.

This model alone does not explain much. What happens looks like an outcome of a control action and should take place at the level of MB: the irradiation affects the MB of the E+S complex, which responds at times t_k. One can also assume the TGD inspired view about biocatalysis and look at what this gives.

1. The time $t_1 = 5$ s need not correspond to dark Josephson time for a given enzyme for which has 6 special irradiation times $t_k = t_m + (k_1)\tau_n$, $k = 1, ..., 6$, which are multiples $n_k t_1$ of t_1. This would scale up h_{gr} by n_k and v_0 would be scaled to v_0/n_k. Therefore one would have a spectrum of $v_0 = 1/n$, with each enzyme allowing 6 different values of n. t_1 would be minimal Josepson time corresponding to maximal $v_0 = c$.

2. What could happen in the transition at t_k? Why certain multiples $n_k t_1$ would define thresholds at which enzyme activity increases? Could one interpret this in terms of MB controlling the E+S complex?

   At these specific moments enzyme action would be affected. If enzymatic action involves a reduction of h_{eff} for flux tubes connecting E and S, one might think that the Δh_{eff} increases and more energy is provided to overcome the potential wall slowing down the reaction. Reaction becomes faster.

3. Could the irradiation induce phase transitions increasing the h_{eff} for these flux tubes. Could these flux tubes be the flux tubes with $h_{eff} = h_{gr}$ and could the phase transition change the value of $v_0 = 1/n$ to new subharmonic and scale h_{gr} by n. The length of flux tubes would increase and the energy liberated in the shortening would be proportional to $\Delta h_{gr} \propto \Delta n$.

   The irradiation corresponds to $f_c(Fe^{++} = 2.27$ eV all the time. If an increasing value of h_{gr} is associated with catalyst flux tubes, alpha frequency must be changed to is sub-harmonic $f_c(Fe^{++}/n$ in each phase transition bringing in longer length scales.

4. Why the transitions should take at such precise values t_k of time characterizing the enzyme? h_{gr} has a number theoretic origin that reflects the polynomial deterministic dynamics at the level of M^8 analogous to Bohr orbit dynamics at the level of H. If quantum non-determinacy has the failure of string determinism for the space-time surface as 4-D soap films with frames as a correlate, one would expect that these phase transitions occur deterministically. One can also ask whether quantum jumps replace polynomial P with a new one.

   Could the times t_k correspond to SSFRs or to the pairs of BSFRs giving rise to quantum tunnelling between the different phases at MB?

   Why should t_k be some integer multiples of t_1. What comes to mind is time crystal structure associated with the 4-D soap film with frames.

5. Threshold effect could be in question. The irradiation could play the role of metabolic energy feed. This might help to understand why the phase transitions occur at times t_k. For instance, the irradiation could transfer dark electrons at flux tubes as in the Pollack effect. It could also induce a phase transition of Bose-Einstein (BE) condensate at the magnetic body of the enzyme (phase transition of a spin glass-like structure analogous to spontaneous magnetization). The obvious possibility is the BE condensate of electron Cooper pairs. The increase of h_{eff} requires energy and when some minimum energy is feeded, the transition occurs.

6. Could laser photons be transfered to the flux tube photons with a rate determined by the flux tube alone as a slow step of the process, where it forms an dark N-photon state. N would increase steadily and when the energy of this state exceeds a threshold defined by the Josephson energy $E_J = 2ZeV$ a Cooper pair is created, which means that MB sends an ordinary photon with this energy to the aromatic ring and kicks out a Cooper pair. The number of laser photons would be such that the energy exceeds the binding energy of p^2 electron pair in the aromatic ring. A rough estimate for this energy as $E \simeq 2(Z^2/n^2)E_H$, $E_H = 13.6$ eV would be about 122.3 eV and gives $N \geq E/22.7 \geq 54$.

7. Why the number of transitions is 6? Could this relate to aromatic 6-ring as a basic object? The electron configuration of C is $[He]2s^22p^2$. There is one p^2 state as an candidate of the Cooper pair for each Carbon atom. Could the 6 steps correspond to a sequence of transitions in which one p^2 state becomes a dark Cooper pair.

3.2.7 Could base pairs act as Josephson junctions?

The basic idea is that each system has a "biological body" (BB) and MB and that BB sends sensory data to MB which in turn controls it. The idea about nuclear membrane as a communicator of sensory data to MB using dark Josephson radiation looks attractive. Is it enough to send the sensory data from the nuclear membrane only? Or could the sensory data from DNA be sent along flux tubes to the nuclear membrane to MB? Or could it be sent directly from DNA? The idea of base pairs as Josephson junctions need not be realistic but deserves to be shown wrong, if not anything else.

1. The sensory communication from DNA using a series of base pair Josephson junctions should utilize dark genetic code based on 3N-photons fused by Galois confinement to longer units like genes. The frequency triplet, 3-chord, must be different for codons, which differ only by the order of letters. This is impossible if one assumes that the letters are independent. The process of adding letters to codon and codons to DNA sequence must be non-commutative and one can speak of a well-defined order. This order naturally corresponds to the orientation of DNA strands.

2. In the number theoretic vision, many particle systems correspond to space-time sheets, which are obtained by $M^8 - H$ duality from a 4-surface of M^8 obtained by holography from the roots of an octonionic continuation of a real polynomial P with rational coefficients. P is obtained as a non-commutative functional composition of real polynomials.

   The spectrum of the roots has an interpretation as quantized virtual mass squared values specifying the mass shells $H^3 \subset M^4 \subset M^8$, which define holographic data. The root spectrum of a composite depends on the order of polynomials in the composite.

   The letters A,T,C,G of codon could correspond to 4 different polynomials P_i, $i = 1, ..., 4$ and codons would be composites of form $P_i \circ P_j \circ P_k$. If the order of functional composition corresponds to the orientation of the strand, it would be opposite for strand and conjugate strand and the 4-surfaces corresponding to strand and conjugate strand would not be simply the same surface but with opposite direction. Only for palindromes, the base pairs A-T and T-A (C-G and G-C) at the opposite ends of the double strand are equivalent if the picture based on polynomial composition is correct. This could explain the different biological roles of strands. Also the halves of many binary structures of biology, such as brain hemispheres could have a similar relationship.

3. Base pair would give rise to a basic Josephson junction between aromatic rings acting as superconductors. These elementary Josephson currents would integrate to to 3N-Josephson junction as a quantum coherent unit. The emitted Josephson photons would be dark 3N-photons analogous to BE condensates.

4. The delocalization of protons in the hydrogen bonds of base pairs A-T and C-G would take place. In the delocalization the proton tends to shift to the direction of the atom to which hydrogen bonding takes place. Protons generate a polarization creating an electric field in which electron Cooper pairs move but at different space-time sheets than protons. This would produce oscillatory Josephson current emitting Josephson photons [K7]. The dark electron Cooper pair currents would originate from the aromatic rings. Note that the Josephson voltage would be the same along all space-time sheets.

5. The pairing of aromatic rings by hydrogen bonds need not be the only way to create dark Josephson junctions. Also Josephson junctions between hydrogen bonded molecules without any aromatic rings can be considered. Pollack effect creates negatively charged exclusion zones (EZs) in water. The protons would be transferred to dark proton sequences at the flux tubes whereas the electrons of EZ would form dark electron Cooper pair condensates generating Josephson currents and Josephson radiation perhaps making possible communications between these systems.

6. An estimate for the Josephson voltage is obtained by assuming that the Josephson voltage scales as the inverse of the size scale of the basic object. For neuron membrane of thickness D=10 nm (for cell membrane the thickness is nearer to 5 nm) is replaced with A-T or C-G pair with thickness of d=.34 nm. This gives an estimate for the energy $E_J = 2eV$ of Cooper the estimate $E_J = (D/d) \times .01$ eV = 3.3 eV (1.75 nm). This energy looks rather reasonable. Interestingly, this is not too far from the energy 2.27 eV associated with the laser photons inducing the Comorosan effect already discussed.

   In Comorosan effect [I27, I3], the irradiation with a laser beam with a photon energy $E_J =$ 2.27 eV would generate the BE condensate of dark Cooper pairs . This might be true also for the base pairs. This should be testable.

3.2.8 Biosystem as a spin glass like system

Spin glasses represent an exotic phenomenon, which remains poorly understood in the standard theoretical framework of condensed matter physics. Actually, spin glasses provide a prototype of complex systems and methods used for spin glasses can be applied in widely different complex systems. Biology is certainly one the most interesting applications.

In [L37] a TGD inspired view about spin glasses is discussed.

1. TGD view about space-time leads to the notion of magnetic flux tubes and magnetic body. Besides spins also long closed magnetic flux tubes would contribute to magnetization. The basic support for this assumption is the observation that the sum of the NFC magnetization and the FC remanence is equal to the NFC magnetization. Magnetic field assignable to spin glass would correspond to a kind of flux tube spaghetti and the couplings J_{ij} between spins would relate to magnetic flux tubes connecting them.

2. Quantum TGD leads to the notion of "world of classical worlds" (WCW) and to the view about quantum theory as a "complex square root" of thermodynamics (of partition function). The probability distribution for $\{J_{ij}\}$ would correspond to ground state functional in the space of space-time surfaces analogous to Bohr orbits.

3. Spin glass is a prototype of a complex system. In the TGD framework, the complexity reduces to adelic physics fusing real physics with various p-adic physics serving as correlates of cognition. Space-time surfaces in $H = M^4 \times CP_2$ correspond to images of 4-surfaces $X^4 \subset M^8_c$ mapped to H by $M^8 - H$ duality. X^4 is identified as 4-surface having as holographic boundaries 3-D mass shells for which the mass squared values are roots of an octonionic polynomial P obtained as an algebraic continuation of a real polynomial with rational coefficients. The higher the degree of P, the larger the dimension of the extension of rationals induced by its roots, and the higher the complexity: this gives rise to an evolutionary hierarchy. The dimension of the extension is identifiable as an effective Planck constant so that high complexity involves a long quantum coherence scale.

   The TGD Universe can be quantum critical in all scales, and the assumption that the spin glass transition is quantum critical, explains the temperature dependence of NFC magnetization in terms of long range large h_{eff} quantum fluctuations and quantum coherence at critical temperature.

4. Zero energy ontology predicts that there are two kinds of state function reductions (SFRs). "Small" SFR would be preceded by a unitary time evolution which is scaling and generated by the scaling generator L_0. This conforms with the fact that relaxation rates for magnetization obey power law rather than exponent law. "Big" SFRs would correspond to ordinary SFRs and would change the arrow of time. This could explain aging, rejuvenation and memory effects.

5. Adelic physics leads to a proposal that makes it possible to get rid of the replica trick by replacing thermodynamics with p-adic thermodynamics for the scaling operator L_0 representing energy. What makes p-adic thermodynamics so powerful is the extremely rapid convergence of Z in powers of p-adic prime p.

Is there an analogy between dark information molecules and spin glasses?

1. The TGD based model for spin glass involves dark flux tubes with a local magnetization and the state could be seen as a kind of flux tube spaghetti. Also the dark variants of basic information could be seen as this kind of flux tube structures.

   Quantum criticality of TGD suggests that the flux tube configuration has a large number of energy degenerate states and that this is essential for morphogenesis controlled by counterparts of dark genes. In fact, the huge non-determinism of Kähler action due to the existence of vacuum extremals with a CP_2 projection, which is Lagrangian manifold, led to the notion of 4-D spin glass. Twistor lift removes the non-determinism and reduces degeneracy by adding to the action a small volume term, whose coefficient is proportional to a length scale dependent cosmological constant. 4-D spin glass degeneracy is expected to reduce to 3-D spin glass degeneracy.

2. Spin and weak isospin distinguishing between dark neutron and proton are in a key role in the proposed model for the dark nucleon realization of the genetic code [L47]. Codons correspond to closed flux tubes containing 3 dark nucleons connected by pion-like flux tube contacts. The states of this object give rise to dark information molecule DX paired with X, X=DNA, RNA, tRNA, and AA. The states correspond to tensor products of spin-isospin states in

representation $4_I \times 4_s$ of 3 dark nucleons with the angular momentum state of string-like flux tube possessing orbital angular momentum L and correspond to $5 \oplus 3$ (spin 2 and spin 1) for DDNA, DRNA and DtRNA and singlet 1 for DAA as representations of rotational group. In spin and nuclear spin degrees of freedom DDNA corresponds to $(1/2, -1/2)_I \otimes 4_s$, DRNA to $(3/2, -3/2)_I \otimes 4_s$ and DtRNA to $2_I \otimes 2_s$. 32 DtRNAs are predicted and this is the minimal number. The pairing of DtRNAs with tRNAs need not be unique.

Remark: Genetic code has a complete (U-C) symmetry and almost complete A-G symmetry with respect to the third nucleotide of RNA codon. These symmetries have an interpretation in terms of rotational symmetry [L47]. What could be the interpretation of purine sequences (A and G) paired with pyrimidine sequences (T and C) in this picture?

Could one understand how the dark information molecules DX (X refers now to DNA, RNA, and proteins P rather than codons and AAs) could control the conformations of X?

1. The spin state of the dark codon varies along the flux tube so that dark information molecules as flux tubes carrying various spin states differ from the simple ferromagnetic or antiferromagnetic system locally. In spin glasses, ferromagnetism and antiferromagnetism compete and the notion of frustration meaning that there is a large number of states with the same free energy implies complexity. Still DX is much more complex that spin glasses.

   One can however ask, whether the variation of the spin state of DX along the flux tube is analogous to the frustration of spin glasses? Could the total (free) energy of the dark nucleon triplet depend only very weakly on the codon content so that the frustration would be maximal and give rise to a maximal representative power.

2. The nuclear spin of the dark nucleon triplet couples with the stringy angular momentum of the closed flux tube of the codon. One can expect similar coupling in longer scales between the total angular momentum of subsequent codons along the flux tube and also with the stringy angular momenta assignable to larger units of DX such as gene, promoter region, or a control region like Alu in the case of DNA. One would have a tensor product of representations of the rotation group for codons and longer basic units. These tensor products decompose to irreps.

   Could various irreps in these decompositions correspond to various flux tube configurations for the units of DX, X= DNA, RNA. DAAs have stringy angular momentum at the level of codons as closed flux tubes. Dark protein (DP) flux tube has angular momentum and it can couple to the angular momenta of DAAs?

   Could this coupling make it possible for the units of DX to control the dynamical geometry of the flux tube as phase transitions between different irreps of the rotation group? Could these transitions occur at quantum criticality?

3. If this picture is correct, the degeneracy of the angular momentum states of the dark information molecules DX (genes, RNA, proteins) would correspond to a degeneracy of the geometric configurations of information molecules X. DX would serve as a control knob. This is just what a morphogenetic field should achieve. The feed of metabolic energy would induce transitions in the quantum spin glass energy landscape. Also protein/DNA/RNA folding and unfolding induced by energy feed could be understood in this manner.

3.3 Communications to and control by MB

Communication from the biological body (BB) to MB and its control by MB would rely on dark photons, which can transform to ordinary photons with a large h_{eff} and vice versa. Molecular transitions would represent one form of control.

1. Cell membranes could act as generalized Josephson junctions generating dark Josephson radiation with energies given by the sum $E_J + \Delta E_c$ of ordinary Josephson energy E_J and the difference ΔE_c of cyclotron energies for flux tubes at the two sides of the membrane. The variation of the membrane potential modulates the Josephson frequency and codes the sensory information at the cell membrane to a dark photon signal sent to MB.

2. The large effects of radiation at ELF frequencies observed by Blackman and others [J1] could be understood in terms of the cyclotron transitions in $B_{end} = .2$ Gauss if "h" in $E = hf$ is replaced with h_{eff}. h_{eff} should be rather large and possibly assignable to the gravitational flux tubes with $\hbar_{eff} = \hbar_{gr} = GMm/v_0$. For the simplest model, M represents the Earth's mass coupling to the small mass m, and v_0 is a parameter with dimensions of velocity expected to have discrete spectrum. The energies $E = h_{eff}f$ of dark photons should be in the biophoton energy range (visible and UV) characterizing molecular transitions [K10, K15].

3. For the value $v_0/c \simeq 2^{-11}$, suggested by the Nottale's model for planetary orbits [E1], the predicted cyclotron energy scale is 3 orders of magnitude higher than the energy scale of visible photons. Several solutions of this problem were considered [L41]. The most plausible solution [L41, L33] is $\beta_0 = v_0/c = 1/2$ for living matter so that gravitational Compton length $\Lambda_{gr} = GM/\beta_0$ equals to Schwartschild radius at the surface of Earth and brings nothing new to the original Nottale hypothesis.

3.3.1 Cyclotron photons and Josephson photons as basic tools of control and communication

By its higher level of "IQ", MB would naturally be the master controlling BB by cyclotron radiation - possibly via a genome accompanied by dark genome at flux tubes parallel to the DNA strands.

1. Cyclotron BE condensates (BECs) of bosonic ions, Cooper pairs of fermionic ions, and Cooper pairs of protons and electrons would appear as dark matter in living systems and the $h_{eff} = h_{gr}$ hypothesis predicts a universal cyclotron energy spectrum in the range of bio-photon energies. Dark matter and MB would use the biological body, defined in very general sense since life is a universal phenomenon in TGD, as a sensory receptor and motor instrument. MB would receive sensory input most naturally as generalized dark Josephson radiation and control it by dark cyclotron radiation.

2. All charged elementary particles and basic biological ions would have dark variants and could define Josephson currents. Dark photons and BE condensate-like states formed from them would give rise to the analogs of morphogenetic fields. Dark Josephson radiation associated with electrets, which are indeed electric dipolar structures, replaces Fröhlich condensates in the TGD framework.

3. The key equation is $f = ZeV/h_{eff}$ which allows to associate low Josephson frequencies with large energies, say the Josephson energy associated with cell membrane to ELF frequency. Second key equation $E_c = \hbar_{eff}f_c = \hbar_{eff}ZeB/m$ assigns to a low frequency, such as EEG frequency, a large cyclotron energy.

4. There is a connection with biophotons [I23, I12, I32, I2, I20, I21], which is a phenomenon having no feasible biochemical explanation. In the TGD Universe, biophotons can be regarded as ordinary photons resulting from the transformation of dark photons to ordinary photons in an energy conserving manner [K10, K15]. This dramatically reduces the wavelength and in this manner couples long and short length scales dynamically.

In ZEO, the field body (FB) and MB correspond to 4-D rather than 3-D field patterns and quantum states correspond to quantum counterparts of behaviors and biological functions. Conscious holograms could be generated as a result of interference of a dark photon reference beam from MB and a dark photon beam carrying the sensory information. This hologram would be read by MB using the conjugate of the reference beam. In ZEO time reversals of these processes also take place. This makes it possible to understand memory as a result of communications with memory mental images.

If one accepts the view that dark Josephson radiation is a universal communication tool in communications between biological body and MB, one can as whether DNA could utilize it. Consider first the situation at the level of the cell membrane.

1. Dark generalized Josephson radiation associated with the generalized Josephson junctions defined by membrane proteins would make possible communication of local sensory data

to MB [K7, K8, K3]. These Josephson junctions are idealizable as continuous Josephson junctions with a geometry of a cylindrical shell. Ground state would correspond to a soliton sequence and the dark variant of nerve pulse would correspond to a perturbation of the soliton sequence propagating like a nerve pulse.

2. The feedback as control actions could take place via genome as transcription of genes or more general gene expression. This would require communications from genome to nuclear membrane to cell membrane perhaps made possible by magnetic flux tubes connecting them. Their braiding would also make possible topological quantum computation type processes [K12, K21, K13].

3. This model generalizes to a model for the communications of "sensory" data from nuclear membrane to MB.

One can consider several analogs of Josephson junctions at the level of DNA double strand and even at the level of DDNA.

1. One can of ask whether the linear structures formed by the electron chains [I30, I28, I29] assigned with the stack of aromatic rings and proton chains defined by longitudinal hydrogen bonds inside the DNA double strand form Josephson junctions so that Josephson currents would consist of protons and electrons.

2. Could Josephson junctions between base pairs make sense? What is missing is the membrane-like structure and nanoscopic Josephson junctions as analogs of membrane proteins. Base pairs could in principle give rise to Josephson junctions if there is voltage between them. In this case, even the analogs of soliton sequences and nerve pulse could make sense.

3. There exists a longitudinal electric field along DNA [L48, L49]. It could be that nucleotides define analogs of Josephson junctions and they might generate collectively dark 3N-photons as generalized Josephson radiation. In this case, the analog of nerve pulse would not make sense.

3.3.2 Control of DNA and other biomolecules by MB

How MB could control the DNA and other biomolecules?

1. Suppose that the monopole fluxes of dark DNA strands generate currents flowing in aromatic rings of strands. Also spin magnetization could be induced and this in turn would genrate currents in aromatic rings. This could give rise to an analog of magnetized state. Also a diamagnet with vanishing total magnetic field perhaps giving rise to superconductivity is generated.

2. The control of the network of formed by the typically linear structures and membranes is an essential part of biosystems in supramolecular scales. Here an analogy with spin glasses is highly suggestive. Spin glass has become a prototype of complex system. They characterized by a local magnetization with a varying direction. Spin glass landscape has fractal energy landscape having valleys inside valleys and p-adic physics suggests an elegant description of it [L37]. This kind of phase would be ideal control tool used by MB.

3. In the TGD framework, spin glass could correspond to a dark magnetized flux tube network. Spin glass phase could couple to biophotons produced from dark cyclotron photons with large h_{eff} transforming to ordinary biophotons of dark photons with a smaller value of h_{eff} and induce transitions between valleys of the energy landscape corresponds to different geometric and topological configurations of flux tubes. Reconnections and changes of flux tube lengths induced by the change of h_{eff} would be basic processes.

4. Braiding would make possible topological quantum computation using magnetizations associated with flux tubes as analogs of qubits. These qubits would be highly stable as magnetized multi-spin systems. Entanglement would be between magnetizations instead of spins. The first version of topological quantum computation discussed in [K12, K13, K21] did not yet involve spin glass hypothesis.

3.4 Dark counterparts of information molecules and dark realizations of genetic code

There are good reasons to expect that genetic code is something very fundamental and realized at the level of fundamental physics. Genetic code relates to information processing and dark matter at MB has higher "IQ" as the dimension of extension of rationals identifiable in terms of h_{eff}. This leads to two realizations of the genetic code in terms of dark photons and dark nucleons and also strongly suggests that the genetic code is a universal phenomenon having many other realizations besides the biological ones.

3.4.1 Dark analogs of the basic information molecules

The basic information molecules DNA, RNA, tRNA and aminoacids (AA) would have dark counterparts in TGD Universe. DDNA, DRNA,DtRNA, and DAAs would serve as sources of dark 3N-photons representing genes and in special case codons. There would be resonance couplings between DDNA and DRNA, DRNA and DtRNA, DtRNA and DAA. Also resonant coupling change the value of h_{eff} and the frequency by energy conservation $E = h_{eff_1} f_1 = h_{eff_2} f_2$. If h_{eff} changes there is only energy resonance.

During the interaction, these systems should be quantum critical in order to make control, communication and sensory sensitivity optimal which suggests that temporary transitions to quantum criticality is basic aspect. Since the increase of h_{eff} requires energy, metabolic energy would be needed to achieve these transitions. The layers of MB with different values of h_{eff} forming a slaving hierarchy would couple by energy resonance.

Also the communications and control of the ordinary biomatter by dark biomatter is needed. There must exist couplings between DX and X. DX-X pairing would represent permanent interaction of this kind of interaction. Since $h_{eff} = h$ does not actually correspond to the minimum value h_0 of h_{eff}, it would seem that resonant interaction must be involved. Energy resonce gives strong conditions on cyclotron transition energies of DX and transition energies of X. The transition energies for X should be chemical transition energies.

That biophotons, which could result from dark N-photons, have energies in visible and UV range, conforms with this picture. This would make possible direct control of chemistry. Also transitions changing molecular conformations could be activated: the energies for them are in THz range and analogs of biophotons in microwave range are highly suggestive. Dark N-photon could consist of dark photons with energy corresponding to Thz range. Vibrational and rotational transitions could be also activated.

3.4.2 Two realizations of genetic code

TGD inspires the proposal of two dark realizations of genetic code whose most recent forms are discussed in [L47].

1. The first realization represents codons as dark nucleon triplets [L15, L21] and the second realization as dark photon triplets that is 3-chords [K14] [L29, L34, L47].

2. The models for dark codons generalize to models of genes. Galois confinement predicts that dark N-particles states are possible. In particular, genes could correspond to dark 3N-nucleon states as a bound state of dark 3-nucleons associated with flux tubes parallel to DNA strands and to dark 3N-photon states as analogs of BE condensate.

   The communications and control would be based on 3N-resonance in which frequency modulated Josephson radiation would produce a sequence of resonance pulses at MB possibly related to nerve pulses. The genetic codon would determine the address of the receiver as in LISP and modulation would encode for the information transmitted.

3. The icosa tetrahedral model of the genetic code introduced as a model of music harmony has justification in terms of icosa tetrahedral tessellation of the hyperbolic space H^3 defining mass shell [L34]. These mass shells define holography and allow explosion of cognitive representations since all algebraic integers are allowed as points. Genetic code would be therefore universal and could also have 2- and 3-D representations. Even cell membranes could define such a representation.

4. One can say that dark matter at MB and Josephson junctions involving the flow of dark ions define morphogenetic fields in the TGD framework and their interactions are based on signals propagating along topological light rays parallel to the flux tubes. N-resonance making possible precise selective receival of the signals and frequency and amplitude modulation codes for the message.

5. The new view about genetic code leads also to a vision about the evolution of language known to be initiated by mutations of only few genes [L51, L52]. The ideas is that the value of h_{eff} increases for the highest layers of MBs associated with these genes and led to the cultural evolution which quite generally corresponds to evolution at the level of MB.

To sum up, dark Josephson and cyclotron $3N$-photons could define the TGD analogs of morphogenetic fields. The communication would be based on $3N$-resonance and information would be coded using frequency and amplitude modulation and would generate a sequence of resonance pulses.

4 Water memory

Water memory, or homeopathy, is still not taken seriously by mainstream biologists although the empirical support is unquestionable. In this section I will discuss the findings of Benveniste's group and Montagnier's group from the TGD point of view.

4.1 Biological signaling by EM means

Yolene Thomas discusses the history of the notion of water memory in the articles " *The history of the Memory of Water*" [I33] in particular the basic findings of Benveniste's group. In [I34] further findings are discussed. These findings serve as bench tests for the TGD view.

4.1.1 Basic findings of Benveniste's group

Yolene Thomas worked in the group of Benveniste. Among other things Benveniste had discovered an allergy test using blood cells known as basophils. At 1980's Jacques Benveniste and Bernhard Poitevin started to study homeopathy. Antibodies causing basophil degranulation were added to water. A repeated dilution together with agitation led to a situation in which the concentration of the molecule was extremely low and should have caused any effects. The solution however induced a degranulation of the biomolecule itself. The finding was in conflict with the standard lock-and-key mechanism. The conclusion was that the information about antibodies might have been transferred to solution during dilution/agitation process by some unknown molecular organization.

The results were checked in other laboratories and eventually an article by Benveniste and Poitevin was published in Nature but induced violent reactions of skeptics. Instead of a scientific committee, Nature sent Magician James Randi and Walter Stewart, a fraud investigator, to the laboratory of Benveniste. They did not find any evidence for fraud. Nevertheless, they concluded that Benveniste had failed to replicate the claimed results.

Although Benveniste becamed isolated from the community, the research continued.

1. It was found that the vigorous agitation involving vortexing was essential for the effect. Pipetting up-and-down did not have the effect.

2. The effect was found to occur also for the dilutions of ethanol and propanol but not for dilutions of dimethyl sulphoxide.

3. Heating, freeze-thawing or ultrasonication suppressed the activity of highly diluted solutions, but not the activity of several active compounds at high concentrations.

   Molecules reacted to heat according to their distinctive heat sensitivity, whereas all highly diluted solutions ceased to be active between 70 and 80 C. This suggests that the mechanism is independent of the nature of the original molecule.

4. It was found that the activity of highly diluted agonists was abolished by the application of 50 Hz magnetic field of strength 150 Gauss for 15 minutes (Earth's magnetic field has strength .5 Gauss and the endogenous magnetic field explaining the findings of Blackman has strength .2 Gauss). There was no comparable effect on original molecules.

What can one conclude from these findings in the TGD framework?

1. Vortex formation could correspond to the formation of magnetic monopole flux tubes which provide a representation for the MB of antigen. Also Z^0 magnetic flux tubes could be involved in TGD based hydrodynamics and accompany hydrodynamic vortices [L39]. The agitation could feed kinetic energy as a metabolic energy feed for primitive non-chemical lifeforms generated at the flux tubes.

   The different effects of freeze-thawing or ultrasonication effects on the antibody and on the diluted solution supports the view that something representing the antigen in some respects was formed at the flux tubes.

   Pollack effect [I15, I16, L5, I24, I35] generating in the presence of say IR radiation negatively charged region as exclusion zones (EZs) suggests that part of protons of water molecules were transferred somewhere.

   The TGD based explanation [L5] is the formation of dark proton sequences at the flux tubes as analogs of nuclei at the flux tubes defining a primitive lifeform utilizing IR radiation as metabolic energy source: metabolic energy feed would increase the value of h_{eff}. These life forms would correspond to MBs assignable to water clusters.

   The flux tubes of MBs would reconnect with the molecules of the MB of antigen and change their thickness to tune into resonance. In this way they would form representations of antigen by mimicking the cyclotron frequency spectrum of the antigen. They could induce the same effects as antigen if the cyclotron frequencies are a basic control tool of biochemistry. Water clusters would catch the invader molecules. This mechanism would underlie the biochemical immune system and biocatalysis.

   One can even ask whether genetic code is realized for these life forms: the restriction of dark nucleon sequences to those consisting of protons gives as outcome 32 codons, the minimum number of tRNA codons.

2. The effect occurs for ethanol and propanol but not for dimethyl sulphoxide. Hydrogen bonding requires OH-groups. Ethanol and propanol have OH groups but not dimethyl sulphoxide so that the hydrogen bonding could explain the difference. The proposal indeed is that water allows long hydrogen bonds with non-standard value of h_{eff} containing delocalized proton or even several protons. This can explain the numerous anomalies associated with the thermodynamics of water.

3. The 50 Hz oscillatory magnetic field abolished the effect. Note that 50 Hz is a cyclotron frequency of ^{7}Li in the "endogenous" magnetic field $B_{end} = .2$ Gauss explaining Blackman's findings and interpreted in the TGD framework as magnetic field assignable to monopole flux tubes. Could it be that the reconnection with flux tubes of MB of the antibody catches parts of its MB and also ^{7}Li ions at it?

   Was the mere oscillatory character of the magnetic field essential or does 50 Hz correspond to a cyclotron or Larmor frequency associated with the magnetic flux tubes so that resonance was involved?

   For instance, could the resonance have abolished dark proton condensates at the monopole flux tubes as life forms mimicking the cyclotron spectrum of the antigen to flux tubes of external nono-monopole magnetic field? Does 50 Hz frequency belong to the ELF spectrum of the antigen?

Between 1992 and 1996, the group of Benveniste learned to transfer molecules signals, in real time, molecular signals indirectly to water or directly to cells. Cells were placed in a 37 C humidified incubator on one coil attached to the oscillator, while an agonist (or vehicle as control) was placed on another coil at room temperature. In one such exploration, it was found that molecular signals

associated with a common phorbol ester could be transmitted by physical means directly to human neutrophils to modulate reactive oxygen metabolite production.

Since 1995 it has been possible to record, digitize, and replay water memory.

4.1.2 Some further findings of Benveniste's group

In the second article "*Biological signaling by EM means* [I34] (`https://cutt.ly/EAe67sy`) Yolene Thomas summarizes some findings of Benventiste's group represented by Benvenist in 1994. The findings were related to cell lines, isolated guinea-pig heart and in vivo in a mouse model.

1. Heavy metal poisoning causes serious disorders, either inflammatory or strinctly immunological. For the isolated cell lines the effects of Cd at very low doses were studied. For 5-10 μM Cd a high mortality was observed. The pre-treatment with non-toxic doses of HD of Cd with dilution log 16-25 or 26-35 for several days, a significant modulation of cellular activation and growth was observed either directly, both before and after the otherwise lethal concentrations.

2. Isolated guinea-pig or rat hearts were perfused at constant pressure in the so called Langendorff system with highly diluted vasoactive amines. ACh, histamine and water above the aorta. Variation in the coronary flow (CF) was observed. Significant effect on CF was observed. Also now the application of 50 Hz magnetic field abolished the effect.

3. HD of silica (cytoxic for macrophages) was applied to mice in vivo. The effect on macrophages was compared for the treated and control mice. The impact on synthesis of paf-aceter, mediator of inflammation and its precursor lyspaf-aceter was studied. Significant differences were observed. Increase in synthesis of paf-aceeter was found. No effect on the synthesis of the precursor in the HD sample was detected.

All these findings conform with the water memory interpretation and TGD based model for it.

4.1.3 Results of other groups

Thomas describes also some findings of other groups.

1. During the period 1990-1994 Endler studied thyroxine controlled morphogenetic regulation of amphibian Rana temperaria in the transition from 2- to 4-legged stage. Animals that were pretreated with HD of thyroxine metamorphosed more slowly. One could interpret this as immunity against the effect of actual thyroxine produced by the organism produced by false thyroxine. Same effect was achieved with electronic circuitry using recorded frequency spectrum with frequences below kHz.

2. Luc Montagnier has studied since 2005 the effect on mycoplasma, HIV and bacteria. Certain bacteria and DNA extracted from bacterial suspension are filtered and diluted, and the HD is found do emit low frequency em waves.

3. What is interesting is that emission stops when the medium gets in close contact with an infected individual. What could this mean?

   In the TGD framework, this question can be reformulated. Suppose that the emission is analogous to biophoton emission and consists of dark (N-)photons, which have transformed to ordinary photons. Could the flux tubes of the representation of the micro-organism or of its DNA in HD reconnect with the infectant flux tubes of infected invidual so that the radiation does cannot leak out anymore as ordinary photons?

4. It is possible to detect the em radiation of HIV DNA even when the RNA of virus has disappeared from blood. Could this mean that HIV DRNA remains in the organism?

5. Montagnier's group has also reporpted that it is possible to reconstruct DNA sequences from the EM signal produced by HD [I10, I9]. I have already discussed the findings these findings from the TGD view point in [L1, L3].

4.2 Water bridging dynamics of PCR chain reaction

This section discusses the article: " *Water Bridging Dynamics of Polymerase Chain Reaction in the Gauge Theory Paradigm of Quantum Fields*" of Montagnier et al [I11](`https://cutt.ly/yArqeJz`) from the TGD view point.

The basic goal is to understand the DNA-enzyme coupling in DNA polymerization. The polymerization process is a highly organized time-ordered sequence of steps with a precise spatial organization. Computer program is the first analog that pops up into mind. DNA polymerization and biocatalysis in general are extremely difficult to understand in a nothing-but-chemistry approach, which suggests a stochastic process in a sharp conflict with these features.

The proposal of authors in accordance with the vision of Fröhlich that quantized dipole electric fields make possible states which are known as Fröhlich condensates but can one argue bringing in quantum field theory is not enough. The coherence of living matter would naturally follow from quantum coherence in long scales but standard quantum theory fails to produce this: the value of Planck constant is simply too small.

The characteristics of the process fits nicely with the basic predictions of ZEO that quantum states are superpositions of space-time surfaces obeying not only determinism dynamics but being analogous to Bohr orbits. This together with hierarchy of Planck constants would also explain the long scale coherence and precise spatial organization.

4.2.1 The findings

Polymerize chain reaction (PCR) is a method of detecting the presence of DNA in a solution. The article reports findings about highly diluted viral or bacterial DNA in water. The solution contains also DNA polymerase (DNAP), which is thermostable up to 80 C and even above it albeit non-functional, This DNAP, briefly Taq, is associated with a heat tolerant strain *T. aquaticus*. *Taq* is used in PCR quite generally. The properties of *Taq* do not seem to be relevant for the findings.

1. Some viral or bacterial DNAs in a very highly diluted agitated solution (HD) $(10^{-6} - 10^{-10})$ emit electromagnetic radiation (EMS). In the ELF range 40-2000 Hz EMS is several orders of magnitudes more intense than elsewhere. The log-log plot of power is in this range linear and there are self-similar fluctuations regarded as a signature of coherent dynamics at microscopic level.

2. This radiation is recorded and the first dilutions show no signal. The recorded radiation pattern generates electric current creating a time dependent magnetic field in a sample containing only water and *Taq* and oligonucleotide primers.

   IT is assumed that coherent nano domains representing DNA are formed in water or cellular water. The signal would be read by *Taq* polymerase in presence of primers and XTPs, X= A,T,C,G. A polymerization of the viral or bacterial DNA is observed by PCR. In the TGD based model [K24] the term "remote replication of DNA" is used. It would seem that *Taq* pairs with coherent nanoscale domains representing DNA and induce a polymerization of ordinary DNA around it.

3. In the second experiment water is replaced with a flask of living cultured tumor cells or in vitro cell lines. DNA polymerization is observed by PCR also now. Cell growth is inhibited and cells die.

How do *Taq* and oligonucleotide primers find each other to make DNA amplification possible?

The proposal is that dipole electric fields define morphogenetic fields somehow representing DNA. These fields are treated in the gauge theory paradigm involving symmetry breaking and generation of Goldstone bosons generating long range correlations as collective modes. But can collective modes really represent detailed information about genetic codons? This is local information in nanometer scale requiring wavelengths of order nm meaning energy of order 10^3 eV for photons and considerably above the natural energy scale of few eV for molecular transitions.

4.2.2 TGD based model for the findings

The TGD explanation for the findings would go as follows.

1. The mechanism to be discussed works in both experiments. The relevant system would be the dark counterpart of DNAP (DDNAP), which would be modified so that it coules only with the DDNA transmitted to the system electromagnetically. In the first experiment DNAP would *Taq* and in the second experiment the DNAP associated with the cells of the sample.

2. The nanoscale domains would correspond to the remotely generated DDNA as flux tubes at which codons are realized as dark nucleon triplets [L47, L29, L34]. The resonance mechanism for the pairing of DDNA and dark DNA polymerase proteins (NDNAP) paired with DNAP proteins applied to DDNA-DDNAP pair could explain the findings in both cases. Dark 3N-nucleons as a representation of dark genes/proteins accompanying ordinary genes/proteins pair via dark 3N-resonance.

3. DDNAP would tune to the cyclotron energies and frequencies of electromagnetically transmitted DDNA by changing the radii of the dark magnetic flux tubes of DDNAP paired with DNAP. Dark 3N-resonance coupling would lead to the polymerization.

   The general mechanism would be the same as in homeopathy and water memory [K4] in which MBs of water clusters tune their flux tubes to the cyclotron energy (and possibly also frequency -) spectrum of the invader molecules and in this manner form its low frequency representation.

4. This mechanism would be the fundamental mechanism of the immune system and of bio-catalysis.

   (a) U-shaped flux tubes would act as tentacles inspecting the environment for invader molecules and eliminate them by reconnection. Flux tubes would continually vary their thickness to vary the frequency scale of their siren's song and the invader molecule would be caught when a reconnection at resonance is formed.

   (b) In bio-catalysis in which reconnections between U-shaped flux tubes to a pair of flux tubes in resonance would form bridges between reactants and catalyst and the reduction of h_{eff} would shorten the flux tubes and bring them close to each other. The energy liberated would help to get over the potential energy wall so that the reaction would proceed swiftly.

5. The magnetic flux tubes of the DNAP would change their thickness so that the cyclotron frequency spectrum of DNAP tunes to that of the DNAP of the EMS emitting system. There would be tuning of the frequency scale and perhaps also frequency ratios to some extent. DNAP would retune within few days and start to resonanate with the frequency the spectrum of the DDNA representing the electromagnetic invader.

6. The tumor cells and in vitro cells would die because their DDNAP tunes to the DDNA of the invader and loses its tuning with the DDNA of the tumor/in vitro cells. What happens if non-tumor cells are used? If the healthy cells do not die, they could have an electromagnetic immune system preventing the modification of the cyclotron frequencies of the flux tubes of their DDNA. This immune system could explain why remote mental interactions between different organisms are very rare [K20].

5 DNA resonance code

The experimental findings represented in three articles by Savelev et al motivated this section. The articles are

- Savelev et al: "*On The Existence of The DNA Resonance Code and Its Possible Mechanistic Connection to The Neural Code*" [I30] (`https://cutt.ly/KAe6BOd`).

- Savelev and Myakishev-Rempel "*Possible traces of resonance signaling in the genome*" [I28] `https://cutt.ly/rArqdlA`
- Savelev et al How the biofield is created by DNA resonance [I29] (`https://cutt.ly/EArqzSL`).

The motivating observation is that molecular gradients and neuronal signals are too imprecise if one wants to understand processes like DNA polymerization.

Gurwitch, Miller and Webb, Burlakov, Montagnier, Meyl, etc... introduced the notion of morphogenetic field, Miller and and Webb assumed that the morphogenetic field is holographic and is generated by DNA.

Th finding of Meyl that there is no dissipation involved with the morphogenetic field, suggests that quantum coherence in long scales is involved and that this coherence might induce the coherence of biomatter.

It is argued that if the morphogenetic field is generated as a dipole field by moving charge carriers, they should have a low mass and be isolated from the cellular water. Base pairs are hydrophobic and this forces the distances of the bases to be minimal whereas the charges of the phosphate tend to make DNA as straight as possible. This leads to a proposal that DNA strands or at least parts of them act as resonators producing the morphogenetic field, which could represent the genetic code as the findings of Montangier et al suggest. It is proposed that the repeating parts of DNA which do not code for proteins and are usually identified as junk DNA could act as kind of quantum antennas.

5.1 Some findings of Burkalov and their TGD based explanation

There are several experimental findings supporting the presence of morphogenetic fields. Gurwitch and Benveniste who studied water memory belong to the pioneers of the field. Also biophotons, which are not discussed in the articles commented in this article, could closely relate to the morphogenetic field.

Burkalov studied fish embryos inside two quartz cuvettes above each other, 50 fish embryos in each cuvete in sealed quartz cuvettes. They are incubated for several days in a metal box lasting for several days. It was found that older embryos inhibit the development of younger embryos.

It was also found that a germanium mirror accelerates the development if a single cuvette is placed on it. Quartz retroreflector prism in turn represses the development and causes abnormalities. Retroreflector has the basic property that it reflects back by 180 degrees independently of the angle of incidence. Reflector reflects in this manner only if the incidence is normal.

Consider now a possible TGD based explanation for the findings of Burkalov.

1. MB has an onion-like hierarchy of layers and would take the role of a morphogenetic field as a controller. Magnetic flux tubes would determine the morphology. Some higher layer of MB could send control commands through the genomic repeats which in turn would control the transcription and other basic processes. Alu repeats involve promoters.

   The lowest level in MB hierarchy would correspond to DDNAs paired with DNAs? Same for other linear information molecules. Higher layers of MB could use genomic repeats as control knobs.

2. The frequency scale for bioharmony changes with aging, and the first guess is that it slows down. Younger embryos have very sensitive MBs able to rapidly modify the flux tube thickness and tune to the external source. Older embryos therefore induce a modification of the frequency scale of the dark flux tubes of younger embryos. Development slows down or stops because the resonance between DDNA and DNA is lost or does not conform with the biological evolutionary age for proteins.

3. In the experiments involving reflector, the dark photons leaking out as ordinary radiation are reflected and leave the system. In retroreflector the ordinary radiation returns back and causes the decoherence of dark N-photons: instead of dark N-photon ordinary photo is absorbed. Could retroreflection slow down the gradual scaling of frequency scale?

5.2 Electron and proton chains along DNA as sources of morphogenetic field?

The proposal is that electron and proton chains along the stack formed by base pairs serve as the source of the morphogenetic field. The proposed electron and proton chains are called HIDERs (Homologous If Decoded Elements, Repetitive).

1. Morphogenetic field is identified as electromagnetic dipole field assigned to DNA. Resonant oscillations of delocalized electron and proton chains in the base stack of DNA are proposed to serve as the source of the field.

2. Hydrophoby pushes bases together and phosphate charges make DNA maximally linear. This volume is insulated.

3. Base pairs of the double DNA strand (A-T, C-G) oscillate between tautomeric states with frequency in the MHz-THz range. G-C base pairs have three tautomeric states whereas A-T has 2 tautomeric states. There are also aromatic rings oscillating between aromatic and non-aromatic states. They are predominantly in non-aromatic states and one can ask whether the switching forth and back between these states has some role in biocontrol.

4. Aromatic rings are suggested to unite into a stack such that electrons are delocalized along this stack. There is evidence for pi electron chains along hydrophobic base stack associated with purine (A,G) stretches. There is also evidence that these stretches get longer during evolution and that they are conserved.

   DNA charge transfer provides support for the electron chain concept. DNA acts as 1-D conductor and semiconductor and both electrons and holes act as charge carriers.

5. The proposal is that proton chains associated with the longitudinal hydrogen bonds, which is introduced as a new notion, exist. Both electron and proton chains would reside inside a linear double-helical crystal with insulation caused by hydrophoby. This suggests that the dissipation of energy for the chains is very low as the experimental findings about the morphogenetic field require.

5.2.1 Genomic repeats as a source of morphogenetic field?

Genomic repeats are introduced as a further key concept.

1. The starting point is the observation that only 1 % of the human genome corresponds to a coding genome. The non-coding is called junk DNA. 2 % of the genome is conserved and non-coding and must have some important function. The function of the rest 97 % is unknown. Introns, which are spliced from mRNA in the maturation of the final mRNA product belong to the non-coding part.

2. Genomic repeats associated with the intronic portions of the genome must have some important function. There are many kinds of repeats. The smallest repeating structure is a single nucleotide. Also 2-,3-,4-, and 5-nucleotide repeats called microsatellites are frequent. Telomeric and centromeric repeats. Telomeric and centromeric repeaters belong to the simplest repeaters. Typical telomeric repeat is 6 bases long GGGTTA. Human telomeres are around 2500 repeats long. The proposal is that they define fundamental resonators.

   Purine (A,G) repeats are identified as the most important repeats. There is evidence that the lengths of purine chains increase during evolution and that they are conserved.

3. Alu repeats are about 300 bp long, appears in primates only, and has the highest number in the human genome. There are about 1.1 million copies of Alu. Alu is an interspersed repeater meaning that it does not repeat periodically but in a random manner. Alus are near genes and strongly bind to nucleosomes and often serve as a crystallization point for chromatin condensation. Alus coil around almost two nucleosomes. Alus are frequent and conserved in gene promoters, which suggests a possible regulatory role.

Alus code for an untranslated RNA so that they decompose to codons. The variations with an Alu sequence in a gene promoter correlate with the transcriptional activity of the gene. Alus are normally silent but are activated during cellular stress. The methylation pattern for Alus vary and this affects the RNA expression. It is not clear whether methylation affects the possible control role otherwise.

Alus are possessed only by primates and the proposal is that Alu makes us humans. Alus would receive the wave information of the morphogenetic field and convert it to bioinformation by controlling gene expression.

5.2.2 Some objections as a manner to end up with the TGD based view

The work of Fröhlich [J2, I14, I19] [J2] has inspired the idea about the fundamental role of electric dipoles in biology (`https://cutt.ly/3AmIKQi`). Electric dipoles would give rise to Fröhlic condensates explain the coherence of biosystems which remains a mystery in standard quantum physics. No direct evidence for them have been found.

There are some objections against the fundamental role of electric dipoles and dipole radiation.

1. In contrast to magnetic moments, the electric dipole moments of elementary particles vanish to extreme accuracy so that electric dipoles should be associated with composite states such as atoms and molecules which are however heavy so that morphogenetic field would be generated by mass motion of DNA and require considerable metabolic energy feed.

2. The time scale of control dynamics should be slow as compared to the time scale of electric dipoles. For instance, DNA transcription involves time scale of order .1 second assignable to alpha rhythm. Cyclotron frequencies in the magnetic field of order Earth's magnetic field correspond to this time scale. It would seem that cyclotron radiation relates more naturally to the notion of a morphogenetic field. Here however the extremely small energy is the problem and led to the $h_{eff} = n \times h_0$, which later emerged from the number theoretic vision of TGD.

3. One can however consider a different realization of the electric dipole idea. Electrets populate biology, which suggests that nano-scopic and microscopic structures formed from dipole-like entities are crucial. Electret property implies a coupling between acoustic and electromagnetic degrees of freedom and is very probably crucial for hearing. Basically acoustic oscillation corresponds in TGD framework to oscillations of flux tubes connecting particles and if for charged particles forming a dipole this coupling becomes possible.

   For instance, in the TGD vision cell membrane can be regarded as a (actually a generalized) Josephson junction and if dark matter hierarchy is accepted, Josephson frequency is given by ZeV/h_{eff} and is very small for large enough h_{eff}. One obtains the desired slow time scale and energy scale just above thermal energy. Also DNA and microtubules have longitudinal electric fields.

   Comorosan effect [I27, I3] means that there are 5 second and 10 second periods associated with molecules. They are not understood but the interpretation in terms of Josephson frequency of a polarized molecular bond is attractive [K9].

Magnetic dipoles at elementary particle and ion level and macroscopic electric dipolar structures like cell membrane, DNA strand and microtubule would play a fundamental role in the TGD inspired biology and the hierarchy of Planck constants would make the interaction between them possible.

It is quite possible that genuine quantum coherence is realized only at the level of MB and the coherence of biomatter is induced by MB and is not genuine quantum coherence. This would solve the problem due to the fact that the standard value of Planck constant does not allow quantum coherence in long scales.

5.2.3 TGD view about the role of genomic repeats

The TGD view about how dark information molecules DDNA, DRNA, DtRNA, DAA couple with each other and with ordinary information molecules has been discussed. One would have a slaving

hierarchy with levels labelled by h_{eff} controlling each other by energy resonance coupling using dark variants of genes as dark 3N-photons analogous to BE condensates.

They would have energies in biophoton range (visible and UV), very probably also in IR range since metabolic energy quantum around .5 eV must be included, and possibly also in microwave photon range and the energy scale of about .2 eV defined by membrane potential.

These transitions would control chemical reactions, induce conformational changes of biomolecules, etc...

The motor actions of MB would naturally induce conformational changes of molecules and also larger objects. The geometric degrees of MB would be behind morphogenesis. Biological growth could quite concretely correspond to the growth of MB meaning increase of h_{eff} of the highest level present in the hierarchy.

How does this view relate to the proposal that repeating DNA sequences serve as antennas, resonators and circuits?

1. HIDERs could be present. Electron and proton spins could be important and DDNA could induce spin magnetization in turn generating magnetic fields inside DNA inducing currents in aromatic rings.

   An interesting question is whether these currents create a magnetization summing up to zero with spin magnetization: one would have perfect diamagnet. Does this mean electronic super-conductivity inside DNA. I have indeed proposed this earlier. The idea that HIDErs serve as electric dipole oscillators does not however look attractive.

2. Repeating DNA sequences, in particular Alus, must have an important role in communication to and control by higher layers of MB. The presence of higher layers of MB conforms with the fact that Alus are not present in non-primates. Also the connection with epigenesis is suggestive.

   Could Alus serve as control knobs or could they send sensory information to MB and therefore play the same role as cell membrane? Could electric dipolar structure play quite generally the role as generators of sensory input and could MB respond by sending cyclotron radiation as a response?

Consider now in more detail the possible role of Alus in the TGD framework.

1. DNA and also Alus carry a longitudinal electric field making it a long dipole. Also codons act as dipoles with dipole moment depending on the codon. Could the idea that the entire Alu acts as a long Josephson junction make sense? This would not allow information transfer using genetic code.

2. Could codons act as Josephson junctions with Josephson energy $Ze\Delta V$ depending on the codon. Could these Josephson junctions form a 3N-Josephson junction generating coherently dark Josephson 3N-photons as sensory input to MB. The modulation of Josephson current would code for sensory input. This would induce a sequence of resonance pulses at the layer of NB producing a feed back sending sensory data to MB, which could induce control actions, such as DNA transcription.

3. From the length of Alu of order $L \sim 10^{-7}$ meters (300 bps/100 codons) the estimate for the Coulomb energy of electro associated with the entire length is about Z^2e^2/L, for opposite charges at the ends of Alu if it has charges $\pm Z$ at its ends. This corresponds to energy of order few eV and is in the biophoton energy range. This would conform with the energy scale of dark cyclotron photons.

   DDNA could serve as the nearest boss of DNA. Also higher levels in the hierarchy of MB layers would realize dark genetic code if the icosa tetrahedral tessellation at H^3 defines a universal realization of genetic code.

   Since genetic code would be used in the communications, the sensory signal would go to MB with dark codons similar to Alu.

4. Somehow a control response should be generated as a response. Suppose that Alus, and perhaps entire DNA, is magnetized. This could be made possible by possible spin polarization of electron chains and/or rotating currents in aromatic rings. Could MB realize control commands by using dark cyclotron 3N-photons absorbed by Alu?

   A universal standard control knob property Alu, or of a repeating unit in general, would allow minimal complexity of the nucleotide content. The flux tube connections would allow targeted control commands such as activation of propometers of gene transcription. Note that Alus also code for RNAs having some function but are most of the time silent and are used only in emergency situations (cellular stress).

There is an interesting experimental finding, which could be seen as a support for the presence of dark UV photons at magnetic flux tubes.

1. The irradiation of cultured mouse fibroblasts at low power millimeter waves at certain wavelengths protects DNA against damaging effects of UV radiations. What comes to mind is the shielding of the biosphere by the magnetic field of Earth: the cosmic radiation sticks to the flux tubes.

2. Could UV radiation be caught by MB flux tubes with large h_{eff} and transform to dark radiation with much longer wavelength? Could some fraction of the millimeter irradiation transform to dark photons with UV energies? Could the flux tubes of MB tune to millimeter radiation so that they become sensitive to it? Could a BE condensate of photons with energy in UV range emerge and serve as induce the BE condensation of ordinary UV photons so that they would be defused?

5.3 Is DNA magnetic?

The article also discusses the possible magnetism associated with DNA. DNA strands seem to behave like pairs of magnets. Ring currents could cause the magnetization but their presence requires an external magnetic field inducing magnetization.

The problem is that in an external magnetic field DNA becomes orthogonal to it and no magnetization is generated. The source of the external magnetic field must stay parallel to DNA which is impossible in standard view about DNA.

The proposal is that the ring currents are induced by some enzyme in the presence of ATP. There is also the question whether the magnetization is static or oscillatory.

The TGD view of DNA as a magnetic system would be following.

1. DNA strands seem to behave like pairs of magnets. Ring currents could generate magnetization. A strong enough magnetic field parallel to strands is needed to induce the magnetization. The DDNA associated with dark monopole flux tubes (no current needed to create the magnetic field), necessarily parallel to DNA, would induce the magnetization of DNA. Connection with DDNA in icosa tetrahedral picture emerges.

2. How DDNA could couple with the DNA magnetization? The magnetic field is strong and from flux quantization it would be of order 100 Teslas. Cyclotron frequency scales are totally different. $f_c(e) \sim 3 \times 10^{11}$ Hz. For $h_{eff} = h$, the cyclotron energy is of order 3 meV and below thermal energy. Could DNA interior be thermally insulated from the environment. $h_{eff} = nh$, $n \sim 10^3$ would give a few eV scale for the cyclotron frequencies.

3. Large h_{eff} cyclotron 3N-photon transforms to a single ordinary photon with much larger energy and is absorbed in ordinary cyclotron transition by DNA magnet and induces motor action of DNA.

4. Control communication from higher layers of MB could take place via repeats whereas for coding regions only the lowest layers of MB, such as DDNA would be involved. Alu regions as control knobs in gene expression controlled by MB. All layers of MB could realize dark genetic code but in a different scale proportional to h_{eff}.

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