Magnetic Sensory Canvas Hypothesis

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Contents

Abstract

There are very general objections against the idea that ultimate sensory representations are realized inside brain. For instance, any computer scientist, unless informed about materialistic dogmas, would argue that the processing of the sensory data must be separated from its representation. How this could occur if sensory and other representations are realized inside brain, is however difficult to see.

In TGD approach these objections lead to the view that the magnetic flux tube structures associated with the primary sensory organs and higher levels of central nervous system define a hierarchy of sensory and other representations outside brain with magnetic flux tubes serving as the sensory canvas to which place coding by magnetic transition frequencies generates sensory sub-selves and associates with them various sensory qualia and features by quantum entanglement. Thus brain could be much like a RAM memory containing a collection of features in random order and the ordering would be induced by the sensory map to the magnetic sensory canvas. MEs define the sensory projections and EEG MEs correspond to our level in this hierarchy of projections. The sizes of these sensory selves are of order ME sizes ($L(EEG) = c/f(EEG)$) and thus or order Earth size at least. Thus TGD based view about sensory representations is a diametrical opposite of the standard view in which sensory representations are miniatures.

The construction of a more detailed model is based on the following assumptions.

1. Sensory qualia are at the level of primary sensory organs having their own magnetic bodies and entangled with the cognitive and symbolic representations of the perceptive field in brain in turn entangled with the points of the sensory magnetic canvas. The entanglement between primary sensory organs and brain and TGD based view about long term memory resolves the basic objections against this view, and one can understand the differences between sensory experience, imagination, dreams, and hallucinations and various strange phenomena like synesthesia, Anton's syndrome, and blind sight.

2. Second essential element is the mirror mechanism of long term memories. To remember something in the geometric past at temporal distance T is to look at a magnetic mirror with length $L = cT/2$. At quantum level quantum entanglement is involved and means sharing of mental images between recent me and the me of the geometric past (or some other self responsible for the memory representations). This requires that magnetic flux tubes involved with long term memories have astrophysical lengths with light year being the natural length unit. For magnetic fields this indeed makes sense. This picture can be applied to construct a model of long term episodal and declarative memories. The magnetic body (the "me") uses brain as a time mirror by generating a negative energy ME representing a signal propagating along magnetic flux tube to the brain and entangling magnetic body with brain. The negative energy ME is time reflected as a positive energy ME able to communicate classical information to the magnetic body possibly using p-adic cognitive code. Phase conjugate laser wave is the physical counterpart of negative energy ME.

   Zero energy ontology (ZEO) has provided a justification and precise definition for the notion of negative energy signal at quantum level. The arrow of time and negative energy have as quantum correlate the boundary of CD at which the state remains invariant under repeated state function reductions which in ordinary quantum theory would leave the state invariant.

3. Libet's findings about strange causal anomalies related to the passive aspects of consciousness support strongly the notion of magnetic body and lead to the conclusion that sensory experiences are geometric memories of magnetic body in time scale of .5 seconds about what happens in at the level of material body. Libet's findings about active aspects of consciousness in turn allow to conclude that motor activity is very much like active precognition and mirror image of sensory perception. A beautiful general scenario unifying sensory perception, long term memories, and motor action emerges and allows to explain phenomena like sensory rivalry difficult to understand in neuro-science framework. It must be however admitted that sensory canvas hypothesis is far from being established even in TGD framework: one can also defend the minimal model in which personal magnetic body is responsible only for the realization of long term memories and sensory, symbolic, and cognitive representations are realized only at the level of the material body.

4. Dark matter hierarchy based on a hierarchy of increasing values of Planck constant predicts a hierarchy of generalized EEGs. The generalized EEGs make it possible for

the magnetic bodies to receive sensory information from biological body and quantum control it. The resulting detailed model of ordinary EEG predicts correctly the band structure and narrow resonance bands.

1 Introduction

There are very general objections against the idea that the ultimate sensory representations are inside brain. For instance, any computer scientist, unless informed about materialistic dogmas, would argue that the processing of the sensory data must be separated from its representation. How this could occur if sensory and other representations are realized inside brain, is however difficult to see. The classical experiments of Libet relating to the active and passive aspects of conscious experience [J25, J8, J3] provide a strong empirical support for the view that signals from central nervous system (CNS) spend.3-.5 seconds to propagate somewhere else. If the propagation occurs with the velocity of light, the distance in question is measured using the circumference of the Earth as a natural unit.

1.1 Sensory Canvas Hypothesis

In TGD approach these objections lead to the view that the magnetic flux tube structures associated with the central nervous system (CNS) could define a hierarchy of sensory, symbolic, and cognitive representations outside brain with magnetic flux quanta of the magnetic bodies serving as the canvas to which place coding by magnetic frequency generates sub-selves (mental images about "simple feeling of existence") and associates with them various sensory qualia and symbolic and cognitive features by quantum entanglement. Thus brain could be much like a RAM memory containing a collection of features in random order and the ordering would be induced only by the sensory map to the magnetic sensory canvas. Are our sensory representations at the magnetic flux tubes of Earth's magnetic field or are personal magnetic bodies needed? Since space travellers experience the world very much like us and have survived, the most plausible conclusion is that the magnetic sensory canvas is personal. This conclusion is also supported by the fact that the value of the magnetic field explaining the harmonics of 15 Hz as Ca^{++} cyclotron frequencies is.2 Gauss rather than.5 Gauss.

1.2 Why The World Is Not Experienced To Rotate As Head Rotates?

The question which originally led to the notion of the sensory magnetic canvas was "Why the world is not experienced to rotate as head rotates?". If one assumes that sensory representations are completely inside the cortex and that the positions of various visual mental images in the visual cortex remain fixed with respect to cortex as is done in the standard neuroscience, the entire sensory representation rotates thus with the head and one could argue that the world is experienced to rotate.

If one accepts the sensory magnetic sensory canvas hypothesis situation changes. Assuming that

1. the objects of the perceptive field induce sensory mental images (sub-selves) already at the level of sensory organs (in particular, retinas) and representations at corresponding magnetic bodies;

2. these mental images, being self-organization patterns, whose boundaries are determined by the gradients of illumination, do not rotate as the head or eye rotates;

3. the points of the retina correspond to fixed points of the visual cortex in topographic way;

4. the projections to the sensory magnetic canvas from the visual cortex occur orthogonally;

one can answer the question. Note that the personal sensory magnetic body is fixed with respect to head and rotates with it whereas the representation projected to it and defining a self-organization pattern does not. In other words, magnetic body acts like a canvas.

MEs define this sensory projection and EEG MEs correspond to our level in this hierarchy of projections. The sizes of these sensory selves are of order ME sizes ($L(EEG) = c/f(EEG)$) and thus or order Earth size at least. Thus TGD based view about sensory and other representations is a diametrical opposite of the standard view in which sensory representations are miniatures.

Some comments about terminology are in order. Sensory representations involve besides the primary sensory qualia the symbolic representations constructed by brain giving meaning for the sensory input. I will use also the phrase "cognitive representation". Space-time correlates for cognitive representations are tentatively identified as p-adic space-time sheets coinciding with real space-time sheets in resolution defined by some cutoff length scale: in general the intersection with real space-time sheets is discrete set of rational points common to reals and p-adic number fields. p-Adic space-time sheets are also identified as correlates for intentions and the realization of intention as action is tentatively identified as a quantum jump replacing p-adic space-time sheet with a real one in such a way that conservation laws are satisfied.

1.3 Model For The Sensory Representations

The construction of a more detailed model is based on the following assumptions.

1. Sensory qualia are at the level of primary sensory organs having their own magnetic bodies and entangled with the cognitive and symbolic representations of the perceptive field in brain in turn entangled with the points of the sensory magnetic canvas. The entanglement between primary sensory organs and brain and TGD based view about long term memory resolves the basic objections against this view, and one can understand the differences between sensory experience, imagination, dreams, and hallucinations and various strange phenomena like synesthesia, Anton's syndrome, and blind sight.

2. Second essential element is the mirror mechanism of long term memories. To remember something in the geometric past at temporal distance T is to look at a magnetic mirror with length $L = cT/2$. At quantum level quantum entanglement is involved and means sharing of mental images between recent me and the me of the geometric past (or some other self responsible for the memory representations). This requires that magnetic flux tubes involved with long term memories have astrophysical lengths with light year being the natural length unit. For magnetic fields this indeed makes sense. This picture is of course dramatically over-simplified. A more realistic model of long term episodal and declarative memories in which the magnetic body uses time mirror mechanism by sending entangling negative energy ME to the brain making possible sharing of mental images. From brain negative energy MEs are time reflected back as positive energy MEs and are possibly amplified. Positive energy MEs can give rise to classically communicated declarative memories. This means that the distance along a flux tube of the personal magnetic body codes for the temporal distance to geometric past.

3. The already mentioned findings of Libet about strange causal anomalies related to the passive aspects of consciousness lead to the conclusion that sensory experiences are geometric memories of the personal magnetic body in time scale of.3-.5 seconds about what happens in at the level of material body. Libet's findings about active aspects of consciousness in turn allow to conclude that also motor activity must involve time mirror mechanism with negative energy topological light rays sent to the geometric past and inducing the neural activity as a response. Without this mechanism we could not survive using.3-.5 seconds old sensory data. A beautiful general scenario for the realization of intentions and unifying sensory perception, long term memories, and motor action emerges and allows to explain phenomena like sensory rivalry difficult to understand in neuroscience framework.

The flux tube structure associated with the Earth's magnetic field could define or at least closely relate sensory canvases of Mother Gaia and of smaller magnetospheric selves. It is quite conceivable that also magnetosphere contains various kinds of representations of the information from brain and body. The local direction of Earth's magnetic field at cortex should fix the orientation of the projectors associated with the sensory representations in the co-rotating inner magnetosphere.

Pyramidal neurons contain magnetic crystals and also haemoglobin molecules are magnetic and their alignment with the local magnetic field of Earth would make this possible.

These representations could be responsible for the third person perspective which is also an integral part of our consciousness: the mechanism providing the third person aspect would be sharing of the mental images by quantum entanglement. Out-of-body experiences and near death experiences could be one particular manifestation for this component of consciousness. The magnetospheric representations could be also responsible for long term memory representations.

There are reasons to believe that also the non-rotating outer magnetosphere might contain representations. For these representations the projectors should be parallel to the flux tubes of a magnetic field which is stationary with respect to Earth. The flux tubes of the outer magnetosphere might be able to penetrate to some extent the inner magnetosphere and attach to brain or body. For instance, the magnetic field created by the magnetic particles in lungs is of the same magnitude as the magnetic field in the plasma sheet at the night side of Earth.

1.4 EEG as a Communication and Control Tool of Magnetic Body

The progress made during the year 2005 in the understanding of the dark matter hierarchy stimulated a quantum leap in many branches of TGD with the model of the magnetic body included. This forced some updating of also this chapter although I tried to not destroy the original flavor of the chapter. I also added a section about about a hierarchy of generalized EEGs associated with the dark matter hierarchy making possible for the magnetic bodies to receive sensory information from biological body and quantum control it. The chapter "The Hierarchy of Generalized EEGs and Dark Matter Hierarchy" [K7] provides a detailed vision about magnetic body as an intentional agent receiving sensory input from the biological body and using it as a motor instrument.

In this chapter a general vision about the magnetic sensory canvas hypothesis is discussed. The discussion continues in [K12]. These chapters are not a reviews of the final results after the dust has settled but document the development of ideas as it has occurred and is still occurring. There are many mammoth bones and little inconsistencies, and often the simple final picture is achieved by a lot of painful sidetracking. The very name "Magnetic sensory canvas hypothesis" of this chapter is a good example of this problem: both symbolic, cognitive and sensory mental images entangle with the magnetic body so that the attribute "sensory" is somewhat misleading. Furthermore, motor control aspect is equally important. Perhaps a better title would be "Magnetic body hypothesis". My sincere apologies for the reader for this: I can do only my best!

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

2 A model for aensory representations, long term memories, and motor actions

In this section a model of sensory representations will be developed from the assumptions that sensory representations are realized on magnetic body (magnetic sensory canvas) and that sensory organs are the seats of the sensory qualia. It turns out that the model is essentially equivalent with the model of long term memories and that its temporal mirror image yields a general model for motor actions. The general vision is inspired by and explains Libet's strange findings about active and passive aspects of consciousness.

2.1 Magnetic Body As The Sensory Canvas

Many-sheeted space-time concept makes it possible to project the sensory, symbolic and cognitive mental images the external world using MEs and magnetic flux tube structures.

1. Place coding by cyclotron frequency scale could easily wake-up mental images representing the positions of the objects of the perceptive field in the magnetic body. A more attractive manner to see the situation is to identify magnetic body as an active perceiver sending

negative energy topological light rays time reflected at the biological body as positive energy topological light rays and providing information about its state much like the ordinary reflection of light provides information about the object of the perceptive field.

2. The distance of the point of the flux tube from the sensory organ could be coded to the thickness of the flux tube which in turn defines the cyclotron frequency. Most naturally, the strength of the field is the strength of the corresponding Maxwellian magnetic field and the density of the magnetic flux tubes is scaled accordingly from the requirement of the quantization of magnetic flux.

3. The radial EEG MEs assigned with the cortical axons in the TGD based model of EEG could serve as projectors having contacts with the magnetic flux tubes of the personal magnetic body. MEs would entangle cortical mental images and sensory mental images at sensory organs with the "simple feeling of existence" mental images at the points of the magnetic body. Note that the magnetic bodies of sensory organs could carry the fundamental sensory representations.

4. The EEG frequency and its harmonics associated with ME would induce magnetic quantum phase transitions at the magnetic canvas and wake-up mental image at a distance corresponding to the estimated distance of the object of the perceptive field but which need not be same. The association of visual colors with the points of the perceptive field would result from the retina-magnetic body entanglement. Auditory experience might involve a similar mapping but might use Z^0 magnetic field as canvas. Also ears contain strong back-projections necessary for auditory dreams.

5. EEG MEs serving as projections to the magnetic canvas results in the cyclotron transitions at the magnetic flux tubes of endogenous magnetic field having strength $\simeq .2$ Gauss (experiments of Blackman and others), which is 2/5 times the nominal value.5 Gauss for the Earth's magnetic field. At the magnetic flux tubes of the personal magnetic canvas similar process occurs. The rate for the transitions should be maximized in both cases. At the magnetic body this is achieved if the super-conduction ion at the magnetic flux tube is first "kicked" to a smaller space-time sheet wherefrom it "drops" back to the magnetic flux tube, and because of its zero point kinetic energy enters into a high n cyclotron state, which in turn decays by emitting harmonics of the cyclotron frequency. The "kicking" is achieved if the ELF ME responsible for the entanglement contain microwave MEs, which generate flux tubes connecting magnetic flux tube with smaller space-time sheets. This in turn leads to the breaking of super-conductivity and primitive metabolic cycle in which ions flow to the atomic space-time sheets and back to the magnetic flux tube. This would mean that the microwave radiation from brain serves as the "food" of the primitive plasmoid like life form representing the simple "feeling of existence" mental image at the magnetic sensory canvas.

   Both the quantum entanglement with the mediation of of ELF MEs giving rise to the fusion of mental images, and a classical communication by the transfer (say) microwave MEs and inducing self-organization at the magnetic body, are involved. This mechanism is the basic mechanism of remote mental interactions in TGD Universe.

6. An entire hierarchy of sensory representations are predicted and also primary sensory organs could have this kind of representations at their personal magnetic bodies. For instance, retinae could carry this kind of representations realized in the same manner as the cortical representations. These representations would entangle with cortical representations.

2.2 The Mental Images At The Personal Magnetic Body

The sizes of the images of the objects of the cortical sensory representation located outside the body would not correspond to the real size of the objects of the perceptive field. The sizes of ELF ME are typically of order Earth size and this gives upper bound for the size of the representative objects. If brain itself generates the magnetic canvas then it might be natural to expect that the scaling factor involved is one but one must be very cautious in making any strong conclusions. The problem are that it is not at all clear how this scaling factor could be achieved and how it could be

useful. Furthermore, the requirement that the magnetic field strength along the flux tube varies very slowly supports the view that the sub-selves at magnetic body ("simple feeling of existence")can have sizes of order ELF ME.

The mapping of the apparent EEG wavelengths to ELF ME lengths $L = c/f$ defined by the formula $\lambda = v/f = (v/c)L$ for EEG frequency f in terms of its apparent wavelength $\lambda = v/f$ would is consistent with the idea that cortical objects could be scaled-up by a factor $c/v \sim 10^7$! Thus these mental images could be even of the order of the size of Earth! If so they could be extremely stable against external perturbations. In particular, the motion of the head and body would not affect the magnetic and Z^0 magnetic fields in this distance scale so that the problem of reference frame would be solved since "me" would be understood as a gigantic magnetic structure using brain and body as a sensory and motor organ. Obviously, this picture is the diametrical opposite provided by the standard neuroscience.

A more detailed model for the sensory representations requires a more comprehensive view about the personal magnetic body. One can make only tentative guesses in this respect.

1. The personal magnetic body interacts with the external world, in particular, with the Earth's magnetic field and with the solar wind carried by the solar magnetic field. Hence the idea about personal magnetic body as a structure analogous to the Earth's magnetosphere is worth of testing. Personal magnetosphere could decompose into a part moving with the physical body and analogous to the inner magnetosphere, and a stationary, highly stretched, part analogous to the outer magnetosphere at the night side of Earth. Also part residing outside the Earth's magnetosphere should be present. Earth's magnetosphere-solar magnetic field interaction would be replaced by personal magnetosphere-Earth's magnetosphere interaction.

2. Solar wind might enclose part of the personal magnetic body inside the Earth's magnetosphere, whereas the interaction with the flux tubes of the Earth's magnetic field could force the flux tubes of the personal magnetic body to be more or less parallel to them. Incoherent summation of the personal and terrestrial magnetic fields, fractality, plus the fact that the field strengths associated with the flux tubes of the personal magnetic body should decrease much slower with the distance from Earth's surface than those of the Earth's magnetic field, are consistent the possibility that the flux tubes of the personal magnetic body with field strengths stronger that of the Earth's magnetic field reside inside the magnetic flux tubes of the Earth's magnetic field in far-away regions. That part of the personal magnetic body which corresponds to field strengths weaker that the strength of the Earth's magnetic field could quite well have size measured in light years.

3. The highly self-organizing plasma sheet at the equitorial plane at the night side of the Earth's outer magnetosphere is an especially interesting structure as far as personal and magnetospheric sensory representations are considered. For the fractal option the plasma sheet of the Earth's magnetosphere would contain plasma sheets inside plasma sheets, in particular the plasma sheets associated with the personal magnetic bodies. Personal and magnetospheric sensory representations would correspond to different levels of the same fractal structure.

4. Also the intra-terrestrial part of the Earth's magnetosphere is important for the magnetospheric sensory representations and, if the fractality hypothesis holds true, also for the personal ones. The strange co-incidences of important cavity resonance frequencies of intra-terrestrial structures with EEG resonance frequencies, and the fractal correspondence between the architectures of brain and magnetosphere [K12] support the view that personal magnetic body extends also to the interior of Earth. The flux tubes of the Earth's magnetic field (with field strength increasing faster than for the flux tubes of the personal magnetic body) would be however contained *inside* those of the personal magnetic body in this region. The intra-terrestrial consciousness would therefore represent sub-...-selves of ours, something analogous to Id whereas magnetospheric sensory representations would correspond to the super ego. This interpretation conforms with the proposal that intra-terrestrial life forms are possible in the many-sheeted space-time, and that crop circle formations could be interpreted as attempts of ITs to communicate about their existence [K5, K6].

5. Probably it makes sense to speak about Z^0 magnetosphere (both solar and terrestrial). Z^0 magnetic flux tube structures are crucial for the model of long term memories [K21], and

the sizes of the flux tube structures associated with the personal Z^0 magnetic body should be measured in light years. This suggests that also much weaker personal magnetic and Z^0 magnetic fields with the lengths of the closed flux tubes measured in light years are relevant.

2.3 Cortex As A Collection Of Attributes Assigned To The Objects Of Perceptive Field Represented At Magnetic Canvas

One of the basic problems related to the understanding of the information processing in brain is how various attributes are assigned to the object of the perceptive field. What is known that brain recognizes features and these features/attributes seem to be located in a more or less random looking manner all around cortex. This brings strongly in mind random access memory or computer game in which various little program modules realized as records in random access memory represent collection of standard sound effects. A strong hint is the empirical evidence for the view that the resonance frequencies associated with the autocorrelation functions of nerve pulse patterns, and thus presumably also coding EEG frequencies, are same for the features associated with a given object of the perceptive field. The challenge is to understand how the picture based on a collection of MEs projecting features to the magnetic canvas could allow to understand what is behind these observations.

The view about MEs associating attributes to the object of the perceptive field by waking up sub-selves in the magnetic flux tube structure serving as a sensory canvas suggests an elegant interpretation for these facts.

1. Brain writes the music played by the sensory organs to notes. Accordingly, cortex can be regarded as a collection of regions specialized to represent various kinds of standard features interpreted as cognitive and symbolic representations for the sensory input whereas sensory qualia are realized at the level of sensory organs. Features need not be simple: arbitrary complicated collections of them, such as symbolic representations familiar faces are also possible features. Even entire dynamical processes (selves) could serve as features. Cortical mental images entangled also with sensory mental images a the level of sensory organs and at various organs. The pain in the heart is really in the heart.

2. Basic feature-regions are like computer records. The information about the position of the feature in perceptive field could be represented by the entanglement of the feature with a particular part of, say, primary sensory area representing a point of the perceptive sphere.

3. The direction of the point of the perceptive field could be coded basically by the direction of the magnetic flux tube emerging from the particular position of the sensory area providing map for solid angles of the perceptive field. The mechanism would be based on resonance with Alfven waves associated with the magnetic flux tubes of personal magnetic body amplifying MEs in the direction of magnetic flux tubes. The length (fundamental frequency) of ME would code for the distance of the point of the perceptive field to the distance of the point of the sensory magnetic canvas. Frequency coding could be achieved by varying the local value of the magnetic field responsible for generating the cyclotron frequency. This coding could be either dynamical or static in which case distance could be most naturally coded to linear structures, most naturally in direction orthogonal to the cortical surface.

4. Features would be basically associated with sensory organs, various neural pathways and brain areas and coded partially by nerve pulse patterns. Features could be practically all kinds of sub-selves generated by brain activity. Primary qualia could be realized at the level of sensory receptors if entire sensory pathways entangle with the magnetic body. It seems that the identification of sensory organs as seats of sensory qualia is the most, and perhaps the only, plausible option in TGD framework.

5. Projector MEs would be orthogonal to the sensory area where they emanate. The topographic mapping of the perceptive field to the sensory areas would guarantee that sensory images would remain stationary under rotations of head: although sensory magnetic sensory canvas would move the image projected to it would be stationary. MEs and magnetic flux tubes must be parallel if Alfven wave resonance is involved. In this manner the experiences could remain

private and the contribution from the other brains would remain negligible. Note however that people in very intimate contact could gradually share there magnetic sensory canvases: the anecdotes about gradually developing telepathic communications between the teachers and students of the meditative practices could involve this kind of sharing of computer screen between several users.

6. In this coding EEG MES would entangle with essentially all symbolic information about the perceptive field and the spectroscopy of consciousness would be realized in a strong sense.

Of course, the extreme flexibility of the entanglement mechanism of binding means that one can imagine almost unlimited number of variants about this basic option and the proposed variant can be defended only as the simplest one found hitherto. One can also allow the possibility that the sequence of entanglements begins from the perceptive field with the primary mental images at the level of sensory organs being entangled with objects of perceptive field.

Fractality suggests that there is a hierarchy of representations. In particular, cortex areas, brain nuclei and even cells could possess their own representations. The inactivity of the primary sensory areas during REM sleep could mean that during dream state sensory representations are non-cortical lower level representations or realized at higher sensory areas. Of course, lower level structures could define the projections to the magnetic sensory canvas also during wake-up consciousness. For instance, relay station like nuclei could act as relay stations for the projections realized at the magnetic body. Any brain area defining topographical map of sensory data is could candidate for defining a sensory representation.

The projector regions could serve as kind of central entanglers. Also the nuclei believed to somehow generate EEG resonance frequencies responsible for the binding of mental images are good candidates for the central entanglers. Thalamus is believed to generate 40 Hz rhythm and is thus a good candidate for the central sensory entangler and projector. Hippocampus generates hippocampal theta and could be the central memory entangler and projector. Frontal lobes generate slow EEG waves during cognitive activities and could act as cognitive entanglers and projectors.

This kind of architecture is expected to be realized at various length scales. Perhaps even at the length scale of genes. The remaining question is how motor activities are realized in this picture. The metaphor for consciousness as a computer sitting at its own terminal, which originally stimulated my personal attempts to understand consciousness, might help here. Computer screen corresponds to the magnetic canvas. The one who sits there presumably corresponds to our magnetic body (as far as conscious-to-us intentions are considered). The central unit corresponds to the brain. Sensory projector MEs are generated automatically by nerve pulse activity and code the picture on the monitor. W MEs as active quantum holograms acting as control commands generating nerve pulse patterns would provide a realization of keyboard. Thus it would seem that those aspects of the computer which are usually not regarded as fundamental in Turing machine paradigm are the most crucial for understanding the brain consciousness and computer programmers seem to mimic what happens inside (and outside) their own brain.

2.4 Place Coding

If the personal magnetic body corresponds to the sensory experiencer and the intentional agent, the distance from the brain along the magnetic flux tube represents the temporal distance to the geometric past. It is however quite possible and even plausible that the length of the magnetic flux tube can code for some spatial distance and even more general geometric data. The arrow of the geometric time would order the spatial points. This kind of mapping from the spatial domain to the temporal domain to the personal magnetic body is naturally induced by any scanning like process performed by CNS, say saccadic motion or EEG waves propagating along cortex. Thus it makes sense to speak about place coding even if one does not assume that our body and environment are mapped to the personal magnetic body in a topographical manner.

The required place coding by frequency is easy to achieve. Any cylindrical flux tube for which magnetic field in the cylindrical coordinates is obtained from a vector potential $A_\phi(z,\rho,\phi) = B(z)\rho$ varying slowly with z gives rise to a magnetic field whose z-component varies slowly with z and for which the radial component $B_{rho} = \partial_z B(z)\rho$ is small. From the quantization of the magnetic flux the flux tube thickness behaves as

$$\frac{r}{r_0} \propto \frac{B_{earth}}{\sqrt{B(z)}} \ ,$$

and flux tube gets thinner if the field strength increases and vice versa. It the strength of the magnetic field is that of Earth's magnetic field at the surface of the retina or secondary sensory organ, one obtains frequency coding

$$\frac{f}{f_{earth}} = \frac{B(z)}{B_{earth}} \ .$$

This means that a given EEG frequency associated with, say color mental image, induces a magnetic quantum phase transition at a definite value of z and wakes up visual sub-self at that position. The resulting experience is colored point at a specific point of the visual field.

Optimal situation is achieved if the gradient of B with respect to z is very small. This would suggest that self sizes are of order of the size of ELF MEs waking-up the mental images. This would mean that the total increment of $B(z)$ along flux tube would be measured using B_{earth} as a natural unit. p-Adic length scale hypothesis suggests that the thickness of the magnetic flux tube varies between two p-adic length scales and thus by a small power of 2.

It deserves to be noticed that a given EEG frequency f can wake up a number of copies of sensory images corresponding to various ions at positions related to each other by

$$\frac{B(z_1)}{B(z_2)} = \frac{A_1 Z_2}{A_2 Z_1} \ .$$

Here A_i and Z_i denote the mass numbers and charges of the ions, results. If $B(z)$ varies very slowly along the flux tube, the number of separate mental images is however small since the condition above cannot be satisfied for too large ratios on the right hand side. If $B(z)$ increases along the flux tube, the images associated with the light ions are nearer to the eye than those associated with the heavy ions.

This observation suggests that ions with nearly the same mass numbers could give rise to multiple sensory representations associated perhaps with same sensory sub-self. Of course, the degeneracy of the mental images might be undesirable and could be eliminated by adjusting the gradient of B to be so small that multiple sensory images are not generated inside given magnetic self. By a small adjusting of the strength of the magnetic field at eyeball or the radius of the secondary visual sensory organ could shifts between various types of ionic visual consciousness could be induced. For heavy ions, isotopic degeneracy would lead to large number of alternative modes of ionic consciousness and this might give rise to enhanced cognitive abilities.

How faithful is the metric correspondence between the visual field and its image at the magnetic body? The answer is to this question is not obvious. Also eyes are accompanied by magnetic bodies which could carry visual representations and primary sensory qualia. It could be that these representation are responsible for all what relates to the experienced metric aspects of the visual field. If this is the case, the representations at the personal magnetic body could be much more abstract and free from the constraint of the isometric correspondence. The hierarchy of sensory areas in brain indeed corresponds to an increasingly higher level of abstraction.

2.5 Magnetospheric Sensory Representations

It is difficult to exclude magnetospheric sensory representations if one accepts the notion of personal magnetic body and representations at it. These representations could give rise to the third person aspect of consciousness. Magnetosphere could contain multi-brained collective selves receiving sensory input from several brains simultaneously. Also Z^0 magnetosphere could contain representations carrying both sensory and and higher level symbolic and cognitive information from several brains.

The location of the magnetospheric representations could be stationary with respect to the inner magnetosphere. This would require that the MEs projecting the information to the magnetosphere emanate from the head in a direction which is fixed with respect to the local direction of the magnetic field of Earth (the MEs associated with the personal magnetic body would project in a direction orthogonal to the surface of cortex). Most naturally this direction would be the direction

of the local magnetic field since this makes possible amplification based on Alfven wave resonance. Stationarity of the directions of MEs projecting to the magnetosphere could be achieved by the interaction of the magnetic dipoles with Earth's magnetic field forcing the directions of the magnetic dipoles to the direction of Earth's magnetic field and thus making brain a compass. Brain is indeed full of magnetic materials, human brain is a compass and humans have magnetic navigation sense.

Also eyes contain magnetic materials and presumably act as compasses so that eyes could generate the required magnetic fields defining a preferred reference frame for visual sub-selves. One can consider a hierarchy of compasses defined by the hierarchy of magnetic fields at various sheets of the many-sheeted space-time. For the sense of balance this kind of a preferred direction is essential.

Also a Z^0 magnetic compass based on Earth's magnetic field and Z^0 magnetic materials is possible. The fact that Z^0 magnetic fields are associated with hearing so closely in TGD framework supports the view that Z^0 magnetic compass could be related to the sense of balance. Children love to spin around. Since all atomic nuclei couple to Z^0 force, this spinning however generates net Z^0 currents generating additional Z^0 magnetic fields perturbing the Earth's Z^0 magnetic field. This in turn could cheat the Z^0 compass. This indeed happens. When the spinning stops, sensation of dizziness results and the world is experienced to spin.

2.6 Remote Mental Interactions And Sensory Magnetic Canvas Hypothesis

Could the possible sensory inputs from other brains to the personal magnetic body interfere with the sensory inputs from "my brain" ? This is probably not the case. It is however possible that the entanglement with the other magnetic bodies and possibly existing magnetospheric multi-brained selves leads to the sharing of mental images. Perhaps this is exactly what happens during sleep and actually makes possible development of social structures and culture. Note that this picture is consistent with what near death experiences and various altered states of consciousness achieved in meditative practices suggest.

There is some evidence for the possibility of a interaction between minds via projected sensory representations. Some dogs are able to anticipate the epileptic attacks of their master and are systematically trained for this purpose. Some dogs have an amazing skill to precognize that their master is coming home: ordinary sensory perception such as olfaction is excluded as an explanation. The practitioners of transcendental meditation claim that collective meditation can have a definite positive effect on conflict situations occurring at the other side of the world proportional to the square of the number of participants (coherence). The vision of Sheldrake [I8] about morphogenetic fields making possible the claimed learning at the level of species could be modelled concretely in terms of this interaction.

The immediate prediction is that large scale phenomena affecting the magnetic field of Earth should have direct effects on our consciousness by the perturbation of the sensory representations at the other side of the world. There would be however no effect on primary sensory qualia if they are seated at the level of sensory organs nor on cognitive and symbolic mental images produced in brain. Telepathic sharing of mental images having would be one possible effect induced by Schumann resonances: the signature would be sensory experience with no neurophysiological correlates (in particular, there would be no back projection to sensory organs).

It is known that the statistics about mental states of patients of mental hospitals demonstrates strong correlation with magnetic storms induced by sun-spots. The magnetic perturbations induced by lightnings known as sferics are known to have a direct effect on EEG and brain functioning [F1]. Tectonic activity, such as Earth quakes, can induce various kinds of hallucinations such as encounters with UFOs and religious experiences [J17] perhaps involving sharing of mental images. Animals are even able to anticipate earth quakes. When the car ferry Estonia suffered a shipwreck for few years ago taking with it almost thousand people into the depths, hundreds of people reported they had experienced a nightmare obviously relating to this event. Sharing of mental images or sensory percepts produced by back-projection from symbolic representations created by or communicated to brain could be in question.

The known general features of remote mental interactions support the view that magnetospheric multi-brained selves serve as a kind of relay station or medium allowing the remote mental viewer

to entangle with the target. Remote viewer would essentially see with the yes of this higher level self [K18, K1].

2.7 Mirror Mechanism Of Geometric Memories

The mirror mechanism of long term memories involves several purely TGD based features [K21].

1. The classical non-determinism making possible time-like quantum entanglement and sharing of mental images.

2. Space-time sheets with a negative time orientation allowing classical signals associated with negative energy MEs to propagate backwards in time and making possible entanglement.

3. The identification of the personal magnetic body as the experiencing intentional agent sending negative energy MEs parallel to the magnetic flux tubes to the brain acting as the time mirror (see **Fig.** `http://tgdtheory.fi/appfigures/timemirror.jpg` or **Fig. ??** in the appendix of this book). This option, forcing to take completely seriously the notion of the magnetic body, provides the most elegant identification of the time mirror discovered hitherto. If brain is identified as the sender of the negative energy MEs, the identification of the mirror and correct timing of pose problems. One possibility is that the closed flux loops associated with the personal magnetic and Z^0 magnetic bodies having sizes of order light years making it possible for negative energy MEs to repeatedly reflect along them and return back to the brain of the geometric past.

4. The possibility of MEs and magnetic flux tubes interacting weakly with the ordinary matter but strongly with living matter in cell length scales.

2.7.1 Time mirror mechanism

Classically the mechanism of long term memory is extremely simple: one looks at time mirror at a distance of one light year and sees oneself in the geometric past at a distance of two years. Since the geometric past changes in each quantum jump, this mechanism explains why our long term memories are so unstable. One could see also other persons in the mirror and this could explain telepathic communications, the communications with the deceased, as well as identification experiences. The most natural identification of the seer is as the magnetic body and the mirror as the brain (my first guess was time mirror image of this!). The distance along the magnetic flux tube would corresponds to the distance to the geometric past.

For the time-mirror model (see **Fig.** `http://tgdtheory.fi/appfigures/timemirror.jpg` or **Fig. ??** in the appendix of this book) of long term memory recall the ULF dark MEs must be generated both at the personal magnetic body and in the brain.

1. At the personal magnetic body cyclotron phase transition would give rise to negative energy neutral MEs sucking energy from the biological body of the geometric past. This radiation would be reflected back to the geometric future as positive energy neutral MEs. The response would depend on the state of the brain. Motor action would differ from memory recall only in that it would involve negative energy W MEs inducing exotic ionization at both ends and leading to a physiological outcome. The entanglement via W MEs could induce direct sensory memories relying on sharing and fusion of mental images.

2. The ULF radiation representing the response to the memory recall would correspond to Josephson radiation giving rise to a scaled up dark EEG in the relevant time scale characterized by the level of the dark matter hierarchy. The de-coherence of higher level dark photons to single ordinary EEG dark photon or their decay to EEG dark photons is probably involved with the memory call and would transform the response from the geometric past to ordinary cognitive and emotional input at personal magnetic body.

The assumption that the lengths scales of MEs and magnetic structures are identical implies that the frequency of ME equal to the magnetic transition frequency f_m fixes the length of the two MEs involved and thus the temporal location of the long term memory in the geometric past:

$$T = \frac{2}{f_m} \ .$$

This represents a frequency coding for the temporal location. In standard physics the idea about brain generating MEs with a frequency scale of the order of the inverse of lifetime does not make sense: in TGD context situation is different since this process occurs in subjective time. By the arguments discussed in more detail below, positive energy neutral MEs are ideal for communication of long term memories to the geometric future. The concrete mechanism for the generation of MEs as associated with transitions between almost degenerate configurations of spin glass with slightly different classical gravitational energies is discussed in [K21].

2.7.2 More detailed model for long term memories

The realization of long term memories might be the basic function of the personal magnetic body.

1. Spontaneous episodal memories would be based on negative energy MEs entangling the geometric now with the geometric past and making possible sharing of mental images. In particular, sensory memories would rely on this mechanism. This mechanism could also make possible only the communication of the desire to remember to the geometric past in the case of an active memory recall and non-episodal memories. One can however wonder what distinguishes the resulting experience from precognition by the self of the geometric past: could it be that to precognize now is to remember in the geometric future? The fact that MEs represent channelled energy means that distance is not a problem as far as energetics is considered.

2. In the case of non-episodal memories the information could be communicated classically from the geometric past as "bits" and be coded into the light like vacuum current associated with ME. If the magnetic body is the "me", positive energy MEs could simply travel along the same magnetic flux tube along which the negative energy ME arrived. Magnetic flux tube would act as a wave guide amplifying ME by Alfven resonance.

3. Neural MEs with negative energies are especially favored for quantum communications. The reasons are many-fold. The interaction with the matter is very weak in long length scales but strong in cellular length scales, negative energy implies that ME is identifiable as a virtual particle and analogous to a part of a Feynman diagram so that no dissipation is involved and quantum communication is possible. The reversal of the arrow of geometric time means also that there is not macroscopic dissipative dynamics which would spoil the quantum coherence.

4. The requirement that the receival process is highly selective suggests a resonance mechanism. This requires that the fundamental frequencies associated with MEs are somehow universal. p-Adic length scale hypothesis indeed predicts hierarchies of universal frequencies. A stronger requirement is that the receiving and sending structures are somehow similar, and many-sheeted space-time allows to realize this kind of option. Negative energy energy ME cannot be emitted unless there is a receiver absorbing the negative energy and in this manner providing energy for the sender by buy now-let others pay mechanism. The time mirrored positive energy ME can even amplify the reflected negative energy signal by stimulated transition to the ground state if the receiver is a many-sheeted analog of a population inverted laser.

5. Negative energy MEs represent time reversed level of the p-adic length scale hierarchy so that the dissipative effects associated with the space-time sheets with the normal arrow of time should not interfere with the quantum communication. This at least, when the energy of the negative energy ME has a magnitude larger than the thermal energy associated with the space-time sheets with which it interacts: there is simply no system which could make a transition to a lower energy state by the absorption of a negative energy ME. Furthermore, since systems with reversed arrow of geometric time are expected to have extremely low density, the dissipative effects in the reversed direction of time are expected to be small. Since the generation of negative energy MEs does not require energy feed, the memory recall to the geometric past occurs more or less spontaneously, and the scanning of the geometric past becomes possible. In the case of precognition precognizer must intentionally receive negative

energy MEs from the geometric future so that energy feed is needed. This perhaps explains why precognition is so rare. Note that p-adic variant of pre-cognition having interpretation as intentionality occurs easily since p-adic energy is conserved only in piecewise manner.

If this picture has captured something essential from the nature of the long term memories, the conclusion is that we are not at the top of the magnetic sensory hierarchy. Human body and brain generates extremely weak magnetic fields and the corresponding magnetic flux tube structures could make possible long term memories. Near death experiences [K4] could be understood in this framework if the weak magnetic fields associated with the higher levels of the fractal hierarchy of magnetic structures utilize brain and body as kind of sensory and motor organs. Note that there is a flux tubes inside flux tubes structure so that ordinary sensory experiences can be associated also with these flux tubes.

2.8 Sensory Perception, Motor Action, And Time

TGD view about sensory perception differs dramatically from that of the standard neuroscience in that sensory organs (plus possibly their magnetic bodies) are carriers of basic sensory representations and the magnetic body rather than body or brain is the experiencer with which we can identify ourselves. Magnetic body is also the intentional agent and both motor action, sensory perception, and long term memory which all involve also intentional elements, are based on the time mirror mechanism. Intentions are represented by p-adic MEs generated at the magnetic body. p-Adic ME is then transformed to a desire about a particular action and represented as a negative energy ME propagating to the direction of the geometric past. Actions are realized as responses to the negative energy MEs as various kinds of neural activities and as a generation of positive energy MEs. A more realistic model involves an entire sequence of this kind of steps proceeding like a sequence of sub-program calls downwards along the hierarchy of the magnetic bodies down to the level of CNS. A good metaphor is obtained by regarding magnetic bodies as bosses in the hierarchy of some organization and CNS as the lowest level ultimately realizing the desire of the big boss.

2.8.1 Sensory organs as seats of qualia

According to the music metaphor, sensory organs are responsible for the music whereas brain writes it into notes by building symbolic and cognitive representations communicated to the magnetic body. Back projection to the sensory organs is an essential aspect of this process and is discussed in [K8]. Sensory perception at the level of magnetic body involves the generation of negative energy MEs entangling with sensory organs involving possibly also brain as an intermediate entangler.

The assumption that sensory organs are carriers of the sensory representations entangling with symbolic representations realized at the level of cortex does not mean any revolution of neuroscience, just adding something what is perhaps lacking [K8]. One can also consider the possibility that sensory organs and their magnetic bodies define the sensory capacitors whose discharges give rise to sensory qualia and that these magnetic bodies give also rise to low level cognitive and emotional representations.

Neuronal/symbolic level would do its best to symbolically represent what occurs naturally at the level of qualia. Color constancy could be understood as a basic characteristic of color qualia represented symbolically at the neuronal level. Center-surround opponency for the conjugate colors is the neural counterpart for the contrast phenomenon in which the boundary for a region of the perceptive field with a given color carries the conjugate color (black-white opponency associated with the luminance is only a special case of this). The contrast phenomenon at the level of visual qualia could derive from the vanishing of the net color quantum numbers for the electrodes of the retinal color capacitors.

The basic prediction is the presence of the back projection at least in the sensory modalities in which hallucinations are possible. MEs with MEs mechanism is the most natural candidate for realizing the back projection, negative/positive energy MEs would realize the back projection based on quantum/classical communications, and the capacitor model of the sensory receptor can be applied to model photoreceptors and retina. This picture integrates nicely with the various speculations about the role of the ciliary micro-tubules in vision. The obvious question is how the

presence and character of the back projection reflects itself in the structure of the sensory pathways and sensory organs.

Basic facts about how gastrulation and neurulation proceed during the development of the embryo, lead to testable hypothesis about the character of the back projection for various sensory modalities. According to the hypothesis, one can speak about "brain senses" and "skin senses" according to whether the back projection is based on quantum or classical communications.

2.8.2 How motor action differs from sensory perception?

There is a deep similarity between sensory perception and motor action in TGD framework, the basic difference being that classical signals propagate in different direction in CNS and in geometric time. Motor action is initiated by the magnetic body by the sending of negative energy to motor organs by generating negative energy MEs, and proceeds by similar processes backwards in the geometric time to the level of brain and magnetic body, very much like an instruction of a boss at the top of organization to the lower levels of hierarchy and induces lower level instructions. The analogy with computer program calls (quantum communications, desires) and their executions (classical signals, actions) is also obvious. Also classical signals from the magnetic body to the body and brain are possible.

Analogous picture applies to sensory perception with motor organs replaced by sensory organs except that the fundamental communications occur to geometric future from biological body to magnetic body via a hierarchy of EEGs. There is however also an active building of sensory percepts by feedback from the magnetic body which selects between quantum superposed alternative percepts already at the level of sensory organs.

Sensory *resp.* motor imagination differ from sensory perception *resp.* motor action only in that the magnetic body entangles with some higher level of CNS. Therefore there is no danger that imagined motor action would become real or that imagined sensory perception would be experienced as real. This picture is in accordance with the idea of quantum credit card implying maximal flexibility, and with respect to the geometric time would mean that motor actions are only apparently initiated from the brain.

2.8.3 Strange time delays of consciousness: experiments related to the active role of consciousness

Libet has carried out classical experiments about active and passive aspects of consciousness [J8, J3]. It has gradually become clear that these experiments can be interpreted as a support for the identification of "me" as the personal magnetic body.The first class of experiments [J25, J3] is related to the active role of consciousness. For example, the human subject moves his hand at free will. What happens is that neurophysiological processes (changes in EEG, readiness potential) start $T_1 = .35 - .45$ seconds before the conscious decision to move the hand whereas the awareness about the decision to move the hand comes $T_2 = .2 - .1$ seconds before the hand movement. Decision seems to be followed by the action rather than action by decision! This is in apparent accordance with the point of view that consciousness is indeed a passive spectator and the act of free will is pure illusion. What is interesting from the p-adic point of view, is that the most plausible estimates for the time delays involved are $T_1 \simeq .45$ seconds and $T_2 = .1$ seconds [J25]. T_1 is very near to the p-adic time scale $T(6, 43) = .4$ seconds and T_2 to the fundamental p-adic time scale $T(2, 127)$ defining the duration of the memetic codon.

One can imagine two explanations for the paradoxal findings. The explanations turn out to be mutually consistent.

1. The geometric past changes in quantum jump

Quantum jump between histories picture explains the time delays associated with the active aspect of consciousness nicely and also gives an example of two kinds of causalities.

1. The simplest assumption is that the subjective experience of the hand movement corresponds to the moment, when subject person experiences that hand movement occurs.

2. The space-time surfaces (resulting as the final state of quantum jump) associated with the new quantum history differ in a detectable manner from the old quantum history already before

the moment of hand movement since otherwise the new space-time surface would contain an instantaneous and discontinuous jump from the initial to final body configuration, which is not allowed by field equations. Same argument applies to the state of brain. $\Delta T \sim .5$ seconds seems to be the relevant time scale.

3. The attempt of the experimenter to be objective means that in an ideal experiment the observations correspond to the new deterministic history in the associated quantum jump and hence experimenter sees neurophysiological processes as the (apparent) cause of the hand movement with respect to geometric time. With respect to the subjective time the cause of the hand movement is the decision of the subject person.

2. Motor action is initiated from the magnetic body and proceeds to shorter length scales in reversed direction of geometric time

The vision that motor actions are initiated by magnetic body by feeding negative energy to motor organs and proceed upwards in CNS in a reversed time direction is in accordance with the idea of quantum credit card implying maximal flexibility and would mean that motor actions are only apparently initiated from brain. Motor organs send negative energy MEs to get metabolic energy, say to cortex. If there is lapse $\sim .5$ seconds involved then the observed lapse would find explanation. This view concretizes the idea about the editing of the geometric past and is consistent with the more general explanation discussed above.

This view about motor action means that it proceeds from long length scales to short ones whereas in the standard neuroscience view motor motor action would be planned and initiated in the brain and proceed to the level of motor organs, from short to long length scales. This certainly seems to be the case if one looks only the classical communications (say nerve pulse patterns). The extreme coherence of and synchrony of motor activities is however in conflict with this picture: neuronal communications are simply too slow to achieve the synchrony. This has been emphasized by Mae-Wan Ho [I7]. Since quantum communications proceed backwards in geometric time, classical signalling such as nerve pulses from brain to motor organs are actually reactions to the initiation of the motor action from the magnetic body.

2.8.4 Strange time delays of consciousness: experiments related to the passive role of consciousness

Libet's experiments [J8] about the strange time delays related to the passive aspects of consciousness have served as a continual source of inspiration and headache. Every time I read again about these experiments, I feel equally confused and must start explanations from scratch.

What is so important and puzzling is that the backwards time referral of sensory experience is so immensely long: about.5 seconds. The time taken for nerve pulses to travel through brain is not more than .01 seconds and the time to arrive from sensory organs is at most.1 seconds (for axon with length of 1 meter and very slow conduction velocity 10 m/s). For the purposes of survival it would be advantageous to have a sensory input with a minimal time delay.

Why then this long delay? TGD inspired answer is simple: the "me" does not correspond to the material body but to the magnetic body associated with the physical body, and is analogous to the manual of electronic instrument, kind of a monitor screen to which sensory, symbolic and cognitive representations are projected by quantum and classical communications. Since the size of the magnetic body is measured using Earth's circumference as a natural unit, the long time lapse results from the finite velocity of light.

The following explanation is a variant of the model of the sensory representations on the magnetic canvas outside the body and having size measured by typical EEG wave lengths. The basic sensory representations are realized at the level of the sensory organs and entangled with magnetic body whereas symbolic representations are either shared as mental images by or communicated classically to the magnetic body. This differs from the original scenario in which sensory representations were assumed to result by classical communications from brain to the magnetic body.

1. Communications from brain to magnetic body

One must consider two kinds of communications from body to magnetic body corresponding to positive energy MEs generated by at least brain and negative energy ME sent by magnetic body

to at least sensory organs. The assumptions are following.

1. Negative energy MEs bound state entangle the magnetic body with the sensory representations realized at the level of sensory organs, and constructed using back projection from brain and possibly also from higher levels. Fusion and sharing sensory mental images is involved. Also the classical communication of memories to magnetic body could be involved with the build up of sensory and symbolic representations at the magnetic body. In both cases sensory representations are memories with the same time lapse determined by the length of the MEs involved, a fraction of second typically if the magnetic body is of an astrophysical size. During sensory and motor imagination magnetic body entangles by negative energy MEs with some higher level of CNS.

2. Symbolic representations in brain can entangle with the sensory representations entangling in turn with the magnetic body so that CNS defines tree like structure with roots corresponding to sensory organs and branches and leaves corresponding to the higher levels of CNS. Direction of attention selects some path along this tree somewhat analogous to the path defining computer file in some subdirectory.

3. Symbolic representations of the perceptive field can be projected to the magnetic body using also classical signalling by positive energy MEs with phase velocity in a good approximation equal to the light velocity. For instance, if perceptive field contains something important, classical signal to the magnetic body could induce the generation of negative energy MEs turning attention to a particular part of perceptive field. Projection to the magnetic flux tubes of the Earth's magnetic field is possible. The spatial direction of the object could be coded by the direction of ME located in brain whereas its distance could be coded by the dominating frequency of ME which corresponds to a magnetic transition frequency which varies along the radial magnetic flux tubes slowly so that place coding by magnetic frequency results. Field pattern could be realized the coding of information to bits in some time scale, perhaps even in the time scale of millisecond associated with the memetic code. Positive energy MEs generated by brain realize the representation and this implies time delay. In the original model it was assumed that the direction and distance of the object of perceptive field are coded as direction and distance at the magnetic body. The representations are expected to be rather abstract, and it might be enough to perform this coding at the level of magnetic bodies associated with the sensory organs.

2. Libet's findings

Libet's experiments [J8] about the strange time delays related to the passive aspects of consciousness serve as a continual source of inspiration and headache. Every time one reads again about these experiments, one feels equally confused and must start explanations from scratch. The following explanation is based on the model of the sensory representations on the magnetic canvas outside the body and having size measured by typical EEG wave lengths [K19].

The basic argument leading to this model is the observation that although our brain changes its position and orientation, the mental image of the external world is not experienced to move: as if we were looking some kind of sensory canvas inside cortex from outside so that the motion of canvas does not matter. Or equivalently: the ultimate sensory representation is outside brain at a fixed sensory canvas. In this model the objects of the perceptive field are represented on the magnetic canvas. The direction of the object is coded by the direction of ME located on brain whereas its distance is coded by the dominating frequency of ME which corresponds to a magnetic transition frequency which varies along the radial magnetic flux tubes slowly so that place coding by magnetic frequency results.

According to the summary of Penrose in his book "Emperor's New Mind" these experiments tell the following.

1. With respect to the psychological time of the external observer subject person becomes conscious about the electric stimulation of skin in about .5 seconds. This leaves a considerable amount of time for the construction of the sensory representations.

2. What is important is that subject person feels no time delay. For instance she can tell the time clock shows when the stimulus starts. This can be understood if the sensory representation which is basically a geometric memory takes care that the clock of the memory shows correct time: this requires backwards referral of about .5 seconds. Visual and tactile sensory inputs enter into cortex essentially simultaneously so that this is possible. The projection to the magnetic canvas and the generation of the magnetic quantum phase transition might quite well explain the time lapse of .5 seconds.

3. One can combine an electric stimulation of skin with the stimulation of the cortex. The electric stimulation of the cortex requires a duration longer than .5 seconds to become conscious. This suggests that the cortical mental image (sub-self) is created only after this critical period of stimulation. A possible explanation is that the stimulation generates quantum phase transition "waking up" the mental image so that threshold is involved.

4. If the stimulation of the cortex begins (with respect to the psychological time of the observer) for not more than .5 seconds *before* the stimulation of the skin starts, both the stimulation of the skin and cortex are experienced separately but their time ordering is experienced as being reversed!

   A crucial question is whether the ordering is changed with respect to the subjective or geometric time of the subject person. If the ordering is with respect to the subjective time of the subject person, as it seems, the situation becomes puzzling. The only possibility seems to be that the cortical stimulus generates a sensory mental image about touch only after it has lasted for .5 seconds.

   In TGD framework sensory qualia are at the level of of sensory organs so that the sensation of touch assignable to cortical stimulation requires back-projection from cortex to the skin. The mental images generated by direct stimulation of cortex could be called cognitive this is created first and takes some time. If the construction of cognitive mental images about cortical stimulation and the formation of back projection takes at least about.5 seconds the observations can be understood. Genuine sensory stimulus starts to build cortical mental image almost immediately: this mental image is then communicated to magnetic body.

   For instance, assume that the preparation of cognitive mental image at cortex takes something like.4 seconds and its communication to magnetic body about.1 seconds and that back projection is possible only after that and takes roughly the same time to the sensory organs at skin and back. This would explain the change of time order of mental images.

5. If the stimulation of the cortex begins in the interval $T \in [.25 - .5]$ seconds *after* the stimulation of the skin, the latter is not consciously perceived. This effect - known as backward masking - looks really mysterious. It would be interesting to know whether also in this case there is a lapse of.5 seconds before the cortical stimulation is felt.

   If the construction of cognitive mental image about direct stimulation of cortex takes about.4 second, it does not allow the buildup of cognitive mental image associated with the stimulation of skin. Hence the stimulation of skin does not create conscious cognitive or sensory mental image communicated to magnetic body.

3 First attempts to telate sensory sanvas idea to neuroscience

The challenge to relate sensory canvas hypothesis to the general qualitative features of EEG and to what is known about its evolution. The general knowledge about neural correlates of consciousness could also provide constraints for the model of how sensory representations are constructed. One could also try to find clear tests and even existing evidence for the hypothesis that there indeed are also other than neural correlates of consciousness (MEs projecting to the sensory canvas are obviously the candidate in present case).

There seems to be a general consistency of predictions of sensory canvas hypothesis with what is known about EEG. Mention only the evolution of EEG as the emergence of decreasing EEG

frequency scales; the disappearance of alpha, beta and gamma bands from EEG during sleep; the existence of narrow coherent EEG sub-bands in all EEG bands; and also the complex fractal like coherency structures of EEG difficult to understand if EEG has a purely neural origin.

Brain is active also during sleep. Sensory canvas hypothesis encourages to think that, besides making possible consolidation of long term memories, this activity could serve the purposes of higher level multi-brained magnetic selves representing collective levels of consciousness receiving abstract non-sensory input from several brains at theta and delta frequencies. Of course, interaction could occur also in reverse direction and among other things explain the creative insights often achieved during sleep.

Computer metaphor would suggest that motor actions and sensory representations are basically identical procedures in TGD framework: only the final representation of the data file constructed by brain is different. As found, this is not quite the case: there is time reversal involved. Motor action is like precognitive recall whereas sensory experience is like geometric memory recall.

The considerations below rely on various review articles [E3], [J23, J5] about the recent situation concerning the understanding of EEG. Also the article [J12] about neural correlates of consciousness, and the article [J13] suggesting that primary sensory area V1 is crucial for conscious vision have been very useful in attempt to develop more concrete views about how sensory representations are constructed. I do not hesitate to admit that the model to be discussed is nothing more than a first attempt to relate the general idea of sensory canvas to the complex neuro reality and is severely restricted by my very limited knowledge about neuroscience (I am grateful for Gene Johnson for his patience while trying to teach me some basic facts about conscious brain).

3.1 Anatomical Structure Of The Cortex And Sensory Canvas Hypothesis

The anatomical structure and evolution of cortex inspires definite hypothesis about how brain constructs and realizes sensory representations at magnetic sensory canvas and how magnetic sensory canvas builds up motor actions. In order to avoid confusions I want to stress that sensory representations generated by brain are assumed to be symbolic representations assigning meaning to the raw sensory input and do not involve qualia, which in TGD Universe are most naturally assignable to the sensory organs.

3.1.1 Do primary sensory areas serve as gateways to the fundamental sensory canvas?

Is there single cortical magnetic body or several of them? Do various sensory areas define a hierarchy of magnetic bodies serving as sensory canvases ("sensory" is somewhat misleading here)? There are several arguments supporting the view that primary, and possibly secondary and tertiary sensory areas, but not necessarily higher areas, should be accompanied by separate magnetic bodies.

1. Computer metaphor encourages to consider the hypothesis that sensory representations and motor outputs have essentially the same character just like printout and monitor picture are different outputs of a same file in the case of a computer. First (with respect to the subjective time!) a rough sensory sketch is generated and then more and more details are added and the primary areas activate the final sensory representation just as in the case of motor output. As in the case of motor actions, higher levels of cortex simply select the activated sensory representation to be experienced consciously by us (binocular rivalry). The sequence of quantum entanglements proceeding from the magnetic body down to the magnetic bodies of sensory organs selects what is experienced consciously by us. There is probably a hierarchy of experiencers each characterized by particular selections.

2. The intention for motor activity is realized as p-adic MEs connecting magnetic body by entanglement sequence to motor organs and induces directly action at this level (buy now-let others pay principle and precise targeted realization of intention). This quantum communication like aspect is accompanied by classical communications from magnetic body to cortex and in terms of nerve pulse patterns from cortex to lower levels. Intention can be also initiated at higher level than motor organs and in this case motor imagination is in question.

3. Mental images are entangled with the mediation of the negative energy projector MEs along along magnetic flux tubes connecting magnetic bodies together. Hierarchical sequences of mental images result in this manner, and sensory qualia become associated with various higher level mental images. MEs can be thought of as representing radiation propagating in the wave channel represented by the magnetic flux tube and being reflected repeatedly. MEs need not be only simple cylindrical prototype MEs but can be also curved: this means that the number of reflections need not be too high. Magnetic flux tubes are essentially guides for MEs so that they do not "lose their way".

4. The motor-sensory analogy might provide also other new insights. For instance, basic elements making possible several potential motor actions might exist simultaneously as subselves representing imagined basic modules of motor activity at the level of cortex. The sequence of quantum entanglements would then select the desired motor action, much like the sensory percept is selected in the sensory rivalry. This would be like building a program from a set of active modules selecting some subset of them or selecting one downwards path in a branching tree. The magnetic sensory representations associated with primary sensory organs without the higher level cognitive and symbolic associations could be seen as the counterparts of reflex actions.

3.1.2 Neural correlates of visual consciousness and motor-sensory analogy

The study of the neural correlates of visual consciousness reviewed in [J12] allows to study the reasonability of the primary sensory areas as gateway to sensory canvas hypothesis and its variants.

1. Evolutionary argument suggests that both primary sensory organs and various sensory areas are accompanied by magnetic bodies providing increasingly abstract symbolic and cognitive representations for the sensory input. The neurons at the higher sensory areas indeed become increasingly complex and have increasingly wider receptive fields. In particular, in the case of vision the neuronal receptive fields at V4 and higher areas are also dynamical and determined by the attentional level. Color/orientation information and the information about motion are treated separately in parvo and magno cellular pathways in V1, V2 and V3 but not in V4 (for the organization of the visual pathways see [J18]). These observations encourage the view that sensory areas define a hierarchy of separate magnetic bodies giving rise to more and more integrated conscious higher level representations of the sensory input. These representations define hierarchy of selves using the same brain and body.

2. The standard assumption about feed-forward hierarchy of the sensory areas leads to difficulties. For instance, in binocular rivalry of two competing visual stimuli feed to right and left eye, only the other stimulus is experienced at time. V1 and also V2 and V3 however contain neural representations of both stimuli. It has been also found that during the binocular rivalry the co-varying neural activities (seen by fMRI) in the extrastriatal visual cortex and in prefrontal cortex correlate with the subjective percept (rather than real stimulus) unlike the activity in V1 which represents both stimuli [J16]. The manner to understand this is that quantum entanglement sequences starting from the magnetic body proceed down to sensory organs and select from V1, V2 and V3 only the second stimulus.

3. It is known that neural activity in parietal and frontal regions is involved with the change of the dominating stimulus and that the activity in visual areas is not enough for visual consciousness [J12]. Thus the presence of neural representations of both stimuli in V1 but conscious experience of only one stimulus would support the view that neuronal activity is *not* enough to generate our conscious experience. If the hierarchy of entanglements proceeds from our magnetic body to frontal lobes and from there downwards it is easy to understand why the activity in frontal lobes is essential for selecting the consciously experienced stimulus. Obviously the sensory-motor loop would have counterpart in much longer length scales.

4. V1 seems to be necessary for visual consciousness. Pascual-Leone and Walsh have studied the visual hallucinations induced by transcranial magnetic stimulation [J21]. The stimulation of V1 generates static and colored impressions whereas the stimulation of V5/MT generates moving non-colored phosphenes (in accordance with the fact that "where" type information

processing is color blind and "what type" information processing at lowest levels is motion blind). This picture is consistent with the idea that the fundamental visual representations are realized at retinal magnetic bodies. The back-projections in question would be essential for the "qualiafication" of imagination during dreams and hallucinations.

5. The study also demonstrates that the stimulation of V1 *after*, rather than before, the stimulation of regions V5/MT sending feedback to V1 can prevent the generation of hallucination. Even more, [J13] describes a case in which patient has lost visual consciousness when V1 is not intact. There is indeed a strong neural feedback to V1, V2 and V3 from the higher visual areas V5/MT and area V1 is activated simultaneously with MT in macaque. These findings are in conflict with what one might expect if sensory processing proceeds in strictly feed-forward manner. The necessity of V1 for our visual consciousness is obvious if entanglement sequences go through V1 down to the level of retinas. Feedback would also make possible "coloring" of the sensory map during ordinary wave-up experience. Perception would be creative act already at the level of sensory organs.

6. The timing of the interactions in the visual areas provides further hints about how sensory representations are constructed. According to [J13] that early activation of V1 by magnocellular neurons in LGN occurs 20 ms earlier that the activation by parvocellular neurons. At this time also the feedback from V5/MT arrives to V1. This suggests that sensory map is constructed by making first a rough sketch using the sensory input from the magnocellular pathways (motion and position). For about 20 milliseconds later follows the coloring of the sensory map as well as the association of the higher level features to the map. This order is is consistent with the fact that highly developed parvocellular pathway is a newcomer in the evolution and that the information involved is not so vital for survival. Thus V1 would act as an effective "active blackboard" as has been suggested [J13] and by the sensory-motor analogy in TGD framework.

3.2 EEGAnd Sensory Canvas Hypothesis

The general qualitative features of EEG seem to conform with sensory canvas hypothesis and it seems possible to make relatively concrete suggestions for EEG correlates of sensory qualia, cognition and long term memories.

3.2.1 Why the endogenous magnetic field corresponds to.2 Gauss?

For years I erratically believed that the magnitude of the magnetic field assignable to the biological body is $B_E = .5$ Gauss, the nominal value of the Earth's magnetic field. Probably I had made the calculational error at very early stage when taking Ca^{++} cyclotron frequency as a standard. I am grateful for Bulgarian physicist Rossen Kolarov for pointing to me that the precise magnitude of the magnetic field implying the observed 15 Hz cyclotron frequency for Ca^{++} is .2 Gauss and thus slightly smaller than the minimum value.3 Gauss of B_E. This value must be assigned to the magnetic body carrying dark matter rather than to the flux quanta of the Earth's magnetic field. This field value corresponds roughly to the magnitude of B_E at distance 1.4R, R the radius of Earth.

Dark matter hierarchy leads to a detailed quantitative view about quantum biology with several testable predictions [K7]. Number theoretical arguments suggest a general formula for the allowed values of Planck constant [K32] $h_{eff} = nh$ with n a product of two integers n_1 and n_2. The values of integers forn_i which the quantum phase is expressible using only iterated square root operation are number theoretically preferred and correspond to integers n_i expressible as $n_i = 2^k \prod_n F_{s_n}$, where $F_s = 2^{2^s} + 1$ is Fermat prime and each of them can appear only once. The lowest Fermat primes are $F_0 = 3, F_1 = 5, F_2 = 17$. The prediction is that also n-multiples of p-adic length scales are possible as preferred length scales. The unit of magnetic flux scales up as $h_0 \to h_n = nh_0$ in the transition increasing Planck constant: this is achieved by scalings $L(k) \to nL(k)$ and $B \to B/n$.

$B_E = .5$ Gauss corresponds to flux quantum for $L(169)$ for ordinary value of Planck constant. $B = .2$ Gauss would correspond to a flux tube radius $L = \sqrt{5/2} \times L_e(169) \simeq 1.58 L_e(169)$, which does not correspond to any p-adic length scale as such for $h_{eff} = h$. $k = 168 = 2^3 \times 3 \times 7$ with $h_{eff} = nh$, $n =_F 1 = 5$ would predict the field strength correctly as $B_{end} = 2B_E/5$ and predict the

radius of the flux tube to be $r = 18$ μm, size of a large neuron. Furthermore, the model for EEG forces to assume that also a field $B_{end}/2$ must be assumed and this gives the minimal flux h_5. Note that $n = 5$ is the minimal value of n making possible universal topological quantum computation with Beraha number $B_n = 4cos^2(\pi/n)$ equal to Golden Mean [K30].

3.2.2 Evolution as emergence of lower EEG frequency scales: dark matter hierarchy

Sensory canvas hypothesis combined with the scaling law suggests an entire hierarchy of sensory canvases. One must however keep mind open for the possibility that the flux tubes of Earth's magnetic field define only single sensory magnetic canvas.

A firm prediction is that evolution should correspond to the emergence of higher level selves characterized by decreasing EEG frequency scales. There are two hierarchies involved. Dark matter hierarchy and p-adic length scale hierarchy and both presumably correspond to evolutionary hierarchies.

Dark matter hierarchy correspond to a hierarchy of values of Planck constant coming for the most general option as ratios and products of two integers. The model for the hierarchy of generalized EEGs [K7] assigns to preferred levels of dark matter hierarchy a typical time scale identifiable as typical time span of memories. The hypothesis about evolution proceeding as the emergence of higher and higher levels of dark matter hierarchy at the level of personal consciousness is very natural.

3.2.3 Evolution as emergence of lower EEG frequency scales: p-adic length scale hierarchy

p-Adic length scale hierarchy defines a hierarchy at each level of dark matter hierarchy and one can ask whether also the emergence of increasingly longer p-adic length scales characterizes evolution.

1. Cerebellar, retinal, and cortical rhythms

The p-adic time scales assignable with the basic rhythms associated with cerebellum, retina, and cortex increase in this order and are consistent with the hypothesis that higher evolutionary levels corresponds to longer p-adic time scales.

1. The fact that the dominating rhythm in cerebellum is about 200 Hz supports the view that it corresponds to shorter p-adic length and time scale than cortex. The fact that cerebellum is responsible for the finer details of motor action is consistent with shorter p-adic time scale.

   If one assumes that 200 Hz rhythm is analogous to sensorimotor rhythm of 13 Hz (Na^+ cyclotron frequency) then scaling then the magnetic field at the field quanta involved should be $\simeq 16$ times stronger than B_{end}. Since B_{end} most naturally corresponds to the p-adic length scale $k = 169$ and magnetic flux $2h_5$, this field could correspond to $k = 169-8 = 161 = 7\times 23$ (scaling down of thickness of flux sheets flux sheets) or $k = 169 - 4 = 165 = 5 \times 53$ (scaling down of the radius of the flux tube). The work of [I3, I4] provides support for the hierarchy of magnetic flux sheets of various thicknesses associated with chromosomes and favors $k = 161$ option.

2. The micro-tremor of retina corresponds to 80 Hz frequency and would relate naturally to 40 Hz thalamocortical resonance frequency if the magnetic field in question corresponds to transversally scaled down magnetic flux sheets having $k = 167$ instead of $k = 169$. Note that $k = 167$ corresponds to the Gaussian Mersenne $(1 + i)^{167} - 1$.

3. Primary sensory areas are dominated by 40 Hz frequency. Lowest frequencies such as hippocampal theta are in turn associated with long term memory which corresponds to high level mental function distinguishing sharply between humans and other species.

2. Why the interpretation in terms of spin flip frequencies does not work?

The original interpretation of cerebellar rhythm was in terms of some magnetic spin flip frequency. Representative examples of spin flip frequencies near cerebellar 200 Hz are $f_s(Na) = 222$ Hz, $f_s(Al) = 218$ Hz and $f_s(Mn) = 208$ Hz, $f_s(Co) = 199$ Hz and $f_s(Sc) = 204$ Hz. Co is obviously the best candidate.

The spin flip frequencies in EEG range (see the table 4) are $f_s(Cl) = 82$ Hz and $f_s(Rb) = 81$ Hz (80 Hz micro-tremor in retina); $f_s(K) = 39$ Hz and $f_s(Y) = 41$ Hz (both very near to 40 Hz thalamocortical resonance frequency); $f_s(Ag) = 34.2$ Hz, $f_s(Rh) = 26.6$ Hz (27 Hz resonance frequency in dog's cortex); $f_s(Ir) = 17$ Hz (narrow band in EEG [J23]), $f_s(Au) = 14$ Hz (the sleeping spindle frequency).

These interpretations are however excluded in the dark matter based view since the ions are assumed to be ordinary ions topologically condensed to dark matter space-time sheets defining λ^k-fold coverings of M^4 so that spin flip photons would be ordinary ones and their energies would be extremely low and much below the thermal threshold. Of course, one must be very cautious with this kind of statements since the ideas about dark matter are still just a collection of rules.

3. p-Adic length scale hierarchy as abstraction hierarchy

This picture suggest an abstraction hierarchy in which EEG frequency scale of projecting EEG MEs correlates with the abstractness of the feature associated with the point of sensory map. For instance, sensory qualia could correspond to gamma frequencies, in particular frequencies near 40 Hz; cognitive features to beta frequencies whereas alpha and theta and delta frequencies to the generation of the long term memories making possible the historical self. The frequencies involved with long term memory recall are expected to correspond to the time span of the memory characterized by the level of the dark matter hierarchy.

4. Objection against p-adic evolutionary hierarchy

If evolution corresponds to emergence of increasingly longer p-adic time scales in EEG, then the naïve application of ontogeny recapitulates phylogeny principle (ORP) suggest that gamma, beta, alpha and theta bands should emerge in this order during the development. This is not the case.

1. According to [J22], the wake-up EEG of infants before 3 months age consists of "fast" background activity. At three months posterior delta rhythm appears at 3-4 Hz and gradually shifts to 6-7 Hz during the first life year. According to [J7], binding related 40 Hz oscillations are evident at the age of 8 months. Also the contrast sensitivity of vision improves rapidly to adult level at this age: this conforms with the hypothesis that EEG is essential for the construction of the sensory representations.

2. According to [J10], [J10], for infants the counterpart of the alpha band appearing in darkness is the occipital rhythmic activity in the range $5.2 - 9.6$ Hz with peak frequency at about 7 Hz and increases gradually. The frequency band $6.0 - 8.8$ Hz with gradually increasing peak frequency at about 7 Hz is activated during visual attention and seems to be the counterpart of sensory-motor rhythm of about 13 Hz of adults. It would be interesting to know whether the sensorimotor rhythm is eventually established via a continuous shift of this band or not.

A direct correlation between body size and frequency scale of the sensory-motor frequency band suggests itself. This might be understood if magnetic flux tubes in the somatosensory part of the sensory canvas get gradually stretched during the growth so that the increasing distances of the body extremities from head are coded by increasing magnetic transition frequencies.

This picture seems to contradict the idea about p-adic evolutionary hierarchy. In TGD framework one must however seriously consider the possibility that the lowest EEG bands relate with the higher level collective and multi-brained sensory representations. These higher level selves could be especially alert during sleep since the entire information processing capacity used for the sensory and motor activities during wake-up state would be freely available. This suggests also a resolution of the objection against p-adic evolutionary hierarchy.

The work of Jaynes inspires the idea about child as a small bicameral nursed by the higher collective levels of consciousness. The location of the sensory motor and alpha rhythms in theta band could indeed be seen as an indication for a kind of magnetic nursery provided higher level magnetic selves and their presence would not corresponds to the infant's consciousness but to the consciousness of the "magnetic nurse". Rather interestingly, according to Jaynes [J14] sitting in mother's lap can induce EEG in infants not possessing stable EEG yet. An interesting question is whether mother's EEG shows a correlation with that of infant and whether it deviates from ordinary EEG in theta band.

The TGD based model of EEG to be discussed in detail later predicts that EEG consists of two copies so that ordinary alpha band has a scaled down copy around 5 Hz. The scaled down copy of EEG is predicted to dominate during sleep. The 7 Hz rhythm in the infant EEG could be interpreted as the scaled down counterpart of the sensorimotor rhythm identifiable in terms Na^+ cyclotron frequency. Infants would be in a state of consciousness analogous to sleep state as far EEG is considered: this of course conforms with the magnetic nursery hypothesis.

3.2.4 EEG rhythms in contrast to evoked and event related potentials

Evoked and event related potentials are believed to be associated with the neuronal activities generated by the sensory stimuli and it seems that they must be distinguished from the narrow frequency bands associated with the sensory and cognitive representations. Indeed, both evoked potentials associated with simple stimuli and event related potentials accompanying more complex stimuli have temporal structure which clearly reflects the propagation of nerve pulses along various parts of brain and one can assign to the peaks of the evoked potentials various a anatomical correlates in the neural pathways involved [J26].

The time-scale systematics for the evoked and event related potentials conforms with the idea of self hierarchy. For instance, brain stem responds to simple auditory stimuli like clicks in time scale is 10 ms: the corresponding frequency is 100 Hz, which is the dominating EEG frequency in brain stem. For cerebellum the corresponding rhythm is about 200 Hz and cerebellum indeed takes care of micro-temporal regulation of motor actions. For higher regions of brain the time scale of event related potentials is typically about 100 ms: this correspond to the time scale of 10 Hz and time scale of memetic code. For instance, at V4 activity starts 100 ms after the onset of the visual stimulus and is peaked around 135 ms.

A good example of an event related potential (ERP) is P300, which is a large positive amplitude ERP following an improbable target in the sequence of repeated target stimuli: P300 occurs with the latency of 300 ms for young adults and for simple stimuli. P300 is preceded by a negative potential called N2 which presumably corresponds to the conscious detection of the target stimulus whereas P300 probably represents the use of this information to update the model about world. N2 contains also information about novelty of the stimulus and the difference of N2 for standard stimulus and novel stimulus is called mismatch negativity.

3.2.5 Coherence of EEG and sensory canvas hypothesis

If the EEG measured at skull relates closely to the sensory representations, it must inherit high coherence from the high coherence of the sensory landscape. Also fractal like hierarchy is predicted. At higher frequencies associated with sensory representations in shorter length scales, coherence should be restricted in shorter range. Indeed, according to [J23], the coherence length for EEG at skull is present and measured by using 10 cm as a natural unit. This coherence could reflect the correlations between neural activities in various parts of brain but it is not at all obvious whether the timing of neural ionic currents can be so sharp that destructive interference cancelling the correlations EEG level does not occur.

According to [J23], very complex structures of coherence in bands around 3, 5 and 7 Hz and 13, 15 and 17 Hz are definitely inconsistent with simple dipole models for the generation of EEG patterns. The findings are however consistent with the view that several distant regions of cortex can project features to the same point of a sensory map and that the coherence reflects the coherence of the sensory map. Coherence regions could naturally correspond to the objects of the perceptive field. The high coherence in the band $4 - 5$ Hz during mental calculations [J23], which certainly represent abstract information processing and involve also long term memory in an essential manner, supports the view that abstract long term memories correspond to lowest EEG bands at 3, 5 and 7 Hz. According to [J23], also increase of coherence between prefrontal and posterior cortical association areas have been reported during working memory retention in the range $4 - 7$ Hz.

The coherence lengths for EEG inside cortex are generally much shorter and complex patterns are encountered. Coherence length of order 2 cm is associated with cortical EEG structures which Freeman introduces as basic units of EEG activity [E3] and calls mesoscopic level of sensory processing. Note that also retina has same size as the mesoscopic structures. Perhaps it is not

accident that this length scale corresponds to the highest ionic cyclotron frequencies in Helium period.

3.2.6 EEG synchrony and negentropic entanglement

If one accepts the vision about life as something in the intersection of real and p-adic worlds 40 Hz EEG synchrony can be interpreted as a correlate for the generation of negentropic entanglement (see **Fig.** `http://tgdtheory.fi/appfigures/cat.jpg` or **Fig. ??** in the appendix of this book) between cortical neurons. Before proposing this interpretation let us first describe the experimental findings of a finnish neuroscientist Antti Revonsuo [J1].

1. Findings

The interpretation for 40 Hz EEG frequency inspired by the binding hypothesis is as a synchronizing frequency necessary for the generation of unified percepts. This hypothesis has been studied using auto-stereograms [J1]. There was no detectable difference in the power spectrum at 36-44 Hz range in the situation when auto-stereogram was experienced as a set of random dots as compared to the situation when it was perceived as a coherent, symmetrical gestalt. The situation was same also in 8-13 Hz and 13-20 Hz beta bands. The finding is consistent with the place coding hypothesis.

On the other hand, when the conscious percept was transformed from a random set of points to a coherent gestalt, there was a detectable increase in 40 Hz power in the occipital and right posterior sites for EEG electrodes in a time window 500-300 ms before the unified percept was reported. There could be also some time lapse between the unified percept and the report about it but probably this cannot explain the entire lapse. No increase of power in beta bands was detected: this might be due to the fact that the widths of the measured bands are much wider than the widths of the narrow sub-bands reported masked by other EEG activity according to [J23]. Note that in the model for a hierarchy of EEGs based on dark matter hierarchy beta band correspond to data communicated to the magnetic body [K7].

That the change in activity is associated with the emergence of a new percept suggests that the temporary increase of the EEG power could be assigned to the communications of the forming percept to the magnetic body.

2. Interpretation in terms of generation of negentropic entanglement

A fresh view about what really happens during 40 Hz synchrony came with the realization that negentropic entanglement is possible in the intersection of real and p-adic worlds. The generation of negentropic entanglement between two sub-selves means that the corresponding mental images are fused [K23, K14]. The process is experienced by the fusing sub-selves as an expansion of consciousness whereas consciousness is lost when when bound state entanglement is generated. Also the meditative states begin with enhanced 40 Hz activity and the interpretation would be same. Quite generally, the generation of negentropically entangled neuron groups could be a correlate for the emergence of a new idea or a new holistic pattern emerging from a chaos. Synchronous firing would be a natural correlate for the synergic state resulting in this manner. The paradoxical looking reduction of the oxiditative metabolism associated with 40 Hz firing could be seen as a signature of reduced dissipation when dissipating ensemble of neurons forms a single quantum coherent system.

What could then be the interpretation of the 300-500 ms time scale and synchronous firing in TGD framework?

1. If one assumes that only brain is involved, one must answer whether the new percept emerges after such a long time period. One would naïvely expect that negentropic entanglement immediately gives rise to the percept. Negentropic entanglement however means that a quantum superposition of several alternative percepts is involved. In the beginning the new percept is present with only small probability so that one would only know that the moment of eureka is quite near (this is indeed the experience that one has) and in the final situation it dominates but not completely since it requires conscious effort to preserve the percept.

2. Also magnetic body should be involved in TGD framework. The natural question is "Why this synchronous neuronal firing?". The natural answer would be that it allows to commu-

nicate the new percept as a consequence of a generation of negentropic entanglement to the magnetic body. The frequency scale of 40 Hz corresponds to a time scale of 25 milliseconds and corresponds to a length scale involved is about $.75 \times 10^7$ m, a good candidate for the size of the part of the magnetic body involved. This time scale is much shorter than 300-500 seconds. If the layer of the magnetic body in question corresponds to the fundamental 100 millisecond time scale assignable to electron as is natural in case of sensory percepts, the time lapse could be essentially due to the communication. If one takes the time scale literally the value of Planck constant which is about 3 to 5 larger than its standard value would suggest itself. Of course, the development of the percept from a fuzzy inkling to the final eureka could involve several communication loops between brain and magnetic body so that the interpretation as a lapse due the slowness of communications need not be inconsistent with the first interpretation.

3. The time scale 300-500 ms could characterize the duration of negentropic entanglement but this is not necessarily the case since negentropic entanglement would be un-necessary after the percept has been represented symbolically so that one knows what is lurking behind the chaos.

3.2.7 Narrow EEG bands and sensory canvas hypothesis

Sensory canvas hypothesis predicts the existence of narrow EEG bands corresponding to the magnetic transition frequencies varying in the range determined by the thickness range for the magnetic flux tubes involved with the sensory representation. The most natural candidates for the magnetic transition frequencies are cyclotron frequencies and their harmonics. There is indeed evidence for this kind of bands [J23].

1. The best known band is alpha band around 11 Hz and has width of order 1 Hz. From this one can conclude that the relative variation of the magnetic field along magnetic flux tubes and thus magnetic flux tube area in the radial direction is roughly 10 per cent so that the radius would vary about 3 per cent. The fact that alpha band at 11 Hz becomes active when eyes are closed is consistent with the interpretation that alpha band corresponds to cyclotron frequencies of bosonic ions and to the motor control by rather than sensory communications to the magnetic body. The activation of the alpha band is also associated with the generation of meditative and "creative" states of mind. Hence one cannot exclude the possibility that alpha band activation corresponds to the projection of some information to the possible multi-brained sensory/cognitive representations associated with higher level collective selves.

2. Besides alpha band Nunez mentions also narrow sub-bands at 3, 5 and 7 Hz at delta and theta range, as well as sub-bands at 13, 15 and 17 Hz in beta band [J23]. That beta disappears when eyes are closed conforms with the interpretation of these bands as being associated with sensory communications to the magnetic body. Hence these bands might be associated with the assignment of cognitive features to the points of the sensory canvas. Indeed, the evolutionary hierarchy sensory representations$\rightarrow$ cognitive representations$\rightarrow$ long term memories involving time like entanglement and making possible historical self, suggests this.

3. 40 Hz band has a width of about 8 Hz, contains several cyclotron frequencies, is associated with the primary sensory areas and disappears during sleep. This suggests that also this band is involved with the projection of the sensory qualia to the sensory canvas. The information about narrow sub-bands of EEG during hypnagogic states (the state between wake-up and sleep involving sensory hallucinations), during the schizophrenic hallucinations and hallucinations generated by sensory deprivation, and during lucid dreaming could provide interesting constraints on the possible sensory quale-EEG frequency correlations.

4. A well motivated guess is that 3, 5 and 7 Hz bands do not correspond directly to the sensory qualia experienced by our magnetic body. Hippocampal theta band (which actually extends from about 4 to 12 Hz) could contain these narrow bands and be involved with the assignment of abstract features, such as concepts and verbal associations and emotions, to the sensory map crucial for the memories. The fact that alpha and theta waves are important during this

period suggests that alpha and theta frequencies are involved with the generation of episodal memories.

Whether the same frequency must be present during memory recall as during the generation of the memory, depends on the model of memory recall. According to the simplest model, memory recall means that an object in the sensory canvas of the geometric past is activated and temporal quantum entanglement mechanism allows us to share the experience. This does not require that the EEG frequency involved with sensory projection is generated in the brain which remembers. Of course, the formation of memory about recalled memory could generate this frequency.

3.3 How To Test The Sensory Canvas Hypothesis

In this subsection some tests for the new vision about sensory canvas hypothesis are proposed and some astrophysical phenomena possibly supporting the basic assumptions behind the new view are considered. The magnetospheric sensory representations associated with Mother Gaia, as opposed to the sensory representations realized at the personal magnetic body, are discussed in [K12].

3.3.1 Some simple tests

One could try to disturb the magnetic flux tubes or MEs responsible for the projection of the visual map to the external world *outside* the body somehow. If the visual experience is modified dramatically, one has an experimental argument supporting the new view. One could perhaps induce also magnetic quantum phase transitions outside the body by stimulating the super-conductors at magnetic transition frequencies and perhaps generate in this manner visual hallucinations. One could generate weak magnetic fields of roughly the same strength as the fields associated with the magnetic canvas and thus superposing with them. Slow modulations of the magnetic fields in these flux tubes might be possible so that cyclotron frequency scale changes and the objects of the perceptive field would be experienced to either contract or expand. Unfortunately (from the point of view of empirical testing), if sensory images are of order ME wavelength $L = c/f$, the sensory images might be extremely stable against perturbations.

One could also study what happens for the vision if the magnetic materials in brain or retina are not present in normal amounts. Or what happens when there is external magnetic field perturbing the magnetic field of Earth inside retina or cortex so that the compass defining the inertial reference frame does not function properly. Does this lead to a sensations associated with dizziness? Could the removal of Earth's magnetic field induce this kind of sensations or affect the visual experience? Probably this is not the case. The general model for EEG predicts that the magnetic flux quanta carrying dark matter responsible for sensory representations and motor control are present even if Earth's magnetic field is cancelled.

3.3.2 Tests for place coding

The hypothesis that EEG frequencies in narrow EEG bands code for the distance of an object of perceptive field can be tested. If subject person directs attention to a moving object of the perceptive field, the peak frequencies inside the narrow EEG bands responsible for the place-coding should shift. The detection of EEG activity in V1 when percept changes in binocular rivalry would support the existence of strictly non-neural correlates of visual consciousness. Negative energy MEs are responsible for the entanglement, and one must ask what it is to detect negative energy MEs. MEs generate coherent light and phase conjugate laser waves at ELF frequencies are what comes in mind first. It is not at all obvious to me how one could observe these. The breakdown of second law in appropriate time scale might be one correlate for the presence of negative energy MEs.

3.3.3 How to test the hypothesis that primary sensory representations occur at the level of sensory organs?

That retinas are involved with the attention is known for some time: directing the attention to an object of the visual field does not necessarily imply directing the gaze to the object [J19]. The amplification of the back-projections from frontal lobes to the part of retina in question is enough,

and if the feedback exceeds a critical value the direction of the gaze is changed. This suggests that the mental image of the object of the perceptive field is realized at the retina and corresponding magnetic body and directing of attention to it feeds metabolic energy to this mental image. If the fundamental visual representation occurs at the level of retinas, the selection of the visual percept in the visual rivalry might be detectable at the level of retinas.

80 Hz frequency is known to be associated with retinas, and one can wonder whether this would determine the size of the magnetic body associated with retina (the size would slightly below Earth radius!). It would be worth of testing whether the pattern of 80 Hz activity associated with retinas correlates with the selection of the sensory percept say in the case of sensory rivalry: certainly this is not what standard neuroscience would suggest but would be worth of testing.

4 Could brain be represented as a hyperbolic geometry?

There are proposals that neuronal systems in brain could have hyperbolic geometry [J6] (`http://tinyurl.com/ybghux6d`) in the sense that neurons could be mappable to a 2-D lattice like structure representable in terms of to 2-D hyperbolic geometry H^2. A concrete identification as a lattice-like structure in H^2 would not be in question.

4.1 A concrete representation of hyperbolic geometry cannot be in question

The tesselations of P^2 represented as Poincare disk have large density of points near the boundary. The concrete geometry of the cortex could very roughly correlate with the geometry of near the boundary of Poincare disk or even boundary sphere of 3-D Poincare ball representing 3-D hyperbolic space H^3. A rather abstract representation based on statistical properties of the network formed by the neurons would be in question. If a genuine geometric representation as a tesselation of hyperbolic space exist it must be realized somewhere else than brain.

To see what is involved, note that the line element of Poincare disk is given by

$$ds^2 = d\eta^2 + sinh^2(\eta)d\phi^2 \quad .$$

to be compared with the line element of ordinary disk given by

$$ds^2 = d\rho^2 + \rho^2 d\phi^2 \quad .$$

For given neuron the size of the radial coordinate η of Poincare disk would correspond roughly to the number of connections it has, kind of popularity. For large values of radial coordinate η the circles of Poincare disk have radius proportional to η and circumference proportional to $sinh(\eta)$ increasing exponentially for large values of η whereas for ordinary disk both radial distance circumference would be proportional to ρ.

For the neurons of cortex, in particular pyramidal neurons, the image points would have large distance from the origin of hyperbolic space. The image points for neurons resembling each other would have small distance with respect to the angular coordinate of the Poincare disk. Since similar neurons can have large distances from each other at the level of brain, the representation must involve a map taking them close to each other.

4.2 Hyperbolic geometry and its tesselations

The standard representations for 2-D hyperbolic geometry are 2-D Poincare plane (`http://tinyurl.com/y8tnklz6`) and Poincare disk (`http://tinyurl.com/y8bcd6cv`). Poincare disk is claimed to be natural representation space for the lattice like structure of neutrons. These lattice structures of H^2 are known as tesselations.

Remark: There is a painting of Escher visualizing Poincare disk. From this painting one learns that the density of points of the tesselation increases without limit as one approaches the boundary of the Poincare disk.

The group $SL(X)$, $X = C, R$, consists of matrices $[a, b; c, d]$ with $a, b, c, d \in X$ satisfying $ad - bc = 1$. The modular group $SL(2, Z)$ acts subgroup of both $SL(2, C)$ and $SL(2, R)$. $SL(2, C)$

resp. $SL(2,R)$ forms a double covering of Lorentz group $SO(1,3)$ *resp.* $SO(1,2) = SL(2,R)$. $SL(2,C)/SU(2) = SO(1,3)/SO(3)$ defines 3-D hyperbolic geometry H^3 realized as $a = \sqrt{t^2 - x^2 - y^2 - z^2} =$ *constant* hyperboloid of future light-cone M^4_+ having $SO(1,3)$ as isometries. $SL(2,R) = SO(1,2)$ acts as isometries of H^2 realizes as hyperboloid of M^3_+. $SL(2,C)$ *resp.* $SL(2,R)$ acts as complex *resp.* real Möbius (conformal) transformations $z \to (az+b)/(cz+d)$, $ad-bc = 1$, of complex plane *resp.* upper half plane.

The modular group $SL(2,Z)$ acting as the subgroup of $SL(2,R) \subset SL(2,C)$ consists of matrices $[a,b;c,d]$ having integer valued elements satisfying $ad-bc = 1$. Alternative definition identifies the elements differing by sign (`https://en.wikipedia.org/wiki/Modular_group`) is a basic example of infinite discrete sub-group.

Modular group is representable as a free product $Z_2 * Z_3$ with generators S *resp.* T subject to relations $S^2 = I$ and $(ST)^3 = I$. Modular group has braid group B_3 of 3 braids as a universal covering group. Modular group has an infinite number of congruence subgroups $\Gamma(N)$ as subgroups. The diagonal elements of $\Gamma(N)$ satisfy $a \mod N = d \mod N = \pm 1$ and $c \mod N = d \mod N = 0$ so that the matrices are equal to $\pm I$ modulo N. There is also a hierarchy of subgroups $\Gamma_0(N)$ for which matrices are upper triangular matrices modulo N.

In TGD one has also p-adic length scale hierarchy with preferred p-adic primes $p \simeq 2^k$. Therefore the groups $\Gamma(p^n)$ are of special interest in TGD framework.

If replaces N with an extension of rationals, one obtains huge hierarchy of subgroups expected to be relevant in TGD framework. One can define the notion of integer also for the extensions of rationals. Algebraic integer is defined as a root of a monic polynomial $P_n = x^n + ...$ with integer coefficients. Also the counterparts of the groups $\Gamma(N)$ can be defined, in particular those associated with $N = p^n$.

H^n, $n = 2,3$ allows infinite number of tesselations as left coset spaces $G\backslash H^n$ of $H^n = SO(1,n)/SO(1,1)$. G is here some infinite discrete subgroup $G \subset SO(1,n)$ of $SO(1,n)$ such as $\Gamma(N)$. For ordinary sphere S^2 the analogs of tesselations are finite lattices and correspond to Platonic solids - tetrahedron, octahedron and cube, and icosahedron and dodecahedron. Tesselations would therefore define hyperbolic analogs of Platonic solids.

The groups $SL(2,Z)/Z_N$ are finite groups. For $N = 3$ one obtains tetrahedral group and $N = 5$ gives icosahedral group. Both groups play central role in TGD inspired model of genetic code [**?**, **?**] but their origin has remained unclear. $\Gamma(N)$ is a normal subgroup $SL(2,Z)$ so that the coset space is group too: $SL(2,Z)/\Gamma(N) = SL(2,Z_N)$. One can represent the elements of group algebra $G(SL(2,Z))$ of $SL(2,Z)$ as entangled elements in the tensor product of $G(SL(2,Z)/\Gamma(N))$ and $G(SL(2,Z_N))$. Number theoretic state function reduction as a "small" state function reduction (SSFR) for elements of $G(SL(2,Z)))$ would project them to unentangled products of elements of $G(SL(2,Z)/\Gamma(N))$ and $G(SL(2,Z_N))$. Maybe genetic code could relate with $\Gamma(N)$ with $N = 3$ and $N = 5$.

4.3 Could magnetic body provide a concrete geometric representation for the tesselation of hyperbolic space?

In TGD framework magnetic body (MB) having an onion-like structure and carrying dark matter as ordinary matter labelled by effective Planck constant $h_{eff} = nh_0$, where n corresponds to the dimension of extension of rationals serving as a kind of IQ. Various quantum scales, in particular quantum coherence length are expected to be proportional to n so that algebraic extensions of rationals define an evolutionary hierarchy with levels labelled by the dimension of extension. Space-time surface for given value of n can be regarded as a covering spaces with n sheets related by the action of Galois group of Galois extension acting as symmetry.

The question is whether one could generalize the hypothesis [J6] (`http://tinyurl.com/ybghux6d`) in TGD framework. In the sequel such a generalization replacing 2-D hyperbolic space with its 3-D counterpart and assuming that the hyperbolic tesselation is associated with MB of brain or of its subsystem considered. This generalization reduces to P^2 if one restricts P^3 to subspace P^2 and restricts $SL(2,C)$ $(SO(1,3))$ as symmetry to cylindrical symmetry $SL(2,R)$ $(SO(1,2))$. Cylindrical symmetry is natural to magnetic flux tubes and cylindrical magnetic flux sheets so that P^2 option might be more natural.

The notion of MB is extremely general and makes sense in all scales, and one can consider the

possibility that the hyperbolic tesselations could provide a kind of universal for the MB of system responsible for cognitive representations.

4.4 Could regions of brain be mapped to tesselations of 3-D hyperbolic space defined by magnetic body?

The question is whether some 3-D lattice-like structures formed by neurons of brain or its subsystem could correspond to tesselations of 2-D or 3-D hyperbolic space H^3 realization as cognitive representations at the MB of brain having hierarchical onion-like structure correlating with hierarchical structure of brain. The tesselation would be defined by an infinite discrete subgroup G of $SL(2,C)$ such that elements are algebraic integers in the extension of rationals. The unit cells of the tesselation would be labelled by elements of G and would therefore define cognitive representation.

One can consider two basic options. Brain or its substructure as 3-D structure is mapped

1. either to a tesselation of H^3 at which $SL(2,C)$ acts as isometries,

2. or to a cylindrically to a tesselation of H^2 at which $SL(2,R)$ acts as isometries represented as upper half-plane or as Poincare disk where the action is as conformal transformation. One can consider also mapping to a complex plane compactified to Riemann sphere at which $SL(2,C)$ acts: now the action is however not as isometries but conformal transformations.

   The interpretation could be in terms of symmetry breaking selecting time axis and spin quantization axis as direction of cylinder.

4.4.1 Some basic facts

Consider first some basic facts about the possible role of 3-D hyperbolic space and its tesselations in TGD.

1. 3-D hyperbolic space H^3 representable as hyperboloid $t^2 - x^2 - y^2 - z^2 \equiv t^2 - r_M^2 = a^2$. a has interpretation as light-cone proper time and in TGD inspired cosmology it corresponds to cosmic time. 2-D hyperbolic space could be seen as subspace of H^3. Now infinite discrete subgroups of $SO(1,3)$ would define tesselations as lattice-like structures. They would serve as 3-D analogs of Platonic solids. I have proposed [K34] that they could explain the astrophysical objects a located along lines with redshifts coming as multiples of a basic redshift in terms of lattice-like structures in cosmic scales.

2. Brain region itself cannot correspond in any manner to a region of H^3 represented as $a = constant = a_0$ hyperboloid. MB of brain region might however do so. The mapping of brain region to the hyperboloid $a = a_0$ could be mediated by gravitational magnetic flux tubes which can be radial since the Kähler flux vanishes in good approximation and there is no conserved monopole flux. Only the cognitive representation as discrete points in extension of rationals would correspond to points of the hyperboloid.

   If MB participates in cosmological expansion assignable to CD, its size would scale up like a as also the cognitive representation associated with the tesselation, whose points would be labelled by discrete infinite subgroup G - say congruence group $\Gamma(N)$ for extension of rationals. In ZEO this means that the part of tesselation inside CD would approach to the boundary of CD (or cd). The finite size of CD would however prevent the expansion to values of $a > T$, T is the size of CD define as the maximal radius of the intersection light-cones involved. It would also prevent MB from reaching the boundary of CD. One cannot therefore exclude cosmic expansion of MB.

3. One can challenge the assumption about cosmic expansion of MB. Quite generally, all known astrophysical objects participate in cosmological expansion by receding from each other as the cosmic redshifts show but do not experience cosmological expansion themselves. TGD solves this paradox by the assumption that cosmic expansion takes place as quantum phase transitions in which expansion occurs in rapid jerks, which correspond to reductions of length

scale dependent cosmological constant Λ by a power of 2 if p-adic length scale hypothesis is accepted [**?**] .

There is evidence that even Earth has experienced this kind of expansion during Cambrian Explosion, which would have increased the radius of Earth by factor 2 [**?**]. This would have been also a giant step in biological evolution as the multicellular life developed in the Earth's interior would have bursted to the surface of Earth and oceans would have formed. An interesting question inspired by the fractality of TGD Universe is whether one could see also the biological growth and development of organs and organelles as sequences of this kind of phase transitions.

This situation might hold true also for MB so that also it should evolve by rapid jerks as the value of Λ is reduced.

4. In TGD space-times are surfaces in $M^4 \times CP_2$. In zero energy ontology (ZEO) they are 4-surfaces in causal diamond (CD), where one has $= cd \times CP_2$, where cd is diamond-like intersection of future and past directed light-cones.

   For light-cone M^4_+ one has a natural slicing is by using the hyperboloids $a = constant$. This slicing would define a natural time coordinate as analog of cosmic time. The usual linear Minkowski coordinates define a second natural natural slicing by $t = constant$ sections, where t is the linear Minkowski time.

   One can define the standard hyperbolic coordinates of M^4_+ by the line element

$$ds^2 = da^2 - a^2(d\eta^2 + sinh^2(\eta)d\Omega^2) \ .$$

   $d\Omega^2 = d\theta^2 + sin^2(theta)d\phi^2$ is the line element of unit sphere S^2. η is the hyperbolic angle identifiable as analog of ordinary angle and having expression

$$tanh(\eta) = \frac{r_M}{t} \equiv \beta$$

   having an interpretation as velocity $\beta = v/c$ n radial direction satisfying $\beta \leq 1$: one has $t = acosh(\eta)$ and $r_M = asinh(\eta)$.

4.4.2 About the precise correspondence between 3-D surfaces and H^3

What could the precise correspondence between 3-D surface giving rise to a cognitive representation of MB and tesselation of H^3 be?

1. The space-time surface representing MB is not hyperbolic space itself but could in some sense have discrete subgroup of $G \subset H^3$ as its symmetries: a possible interpretation would be as cognitive representations [**?**, **?**] consisting of points of H with coordinates in extension of rationals defining the adele [**?**, **?**]. The lattice-like structure associated with 3-surfaces could be mappable to this kind of hyperboloid for some value of a.

   Could the part of MB representing sub-system of brain in question be seen as an intersection of the with $t = T$ section of M^4_+ with the slicing of M^4_+ by $a = constant$ hyperboloids such that magnetic images of neurons as points of the tesselation of H^3 defining cognitive representation would belong to the intersection? For $t > T$ the 3-D structure would be preserved in good approximation.

2. The usual time=constant snapshot in M^4_+ satisfying $t = T$ intersects the hyperboloids with $0 \leq a \leq T$. The condition $t = acosh(\eta) = T$ gives $a = T/cosh(\eta)$ so that a indeed varies in this range. This gives for the radial M^4 coordinate $r_M = asinh(\eta) = Ttanh(\eta)$ giving $r_M \leq T$.

   It seems that this projection is 3-D analog of Poincare disk as a "Poincare ball" of radius $r_M \leq T$ with at least analog of hyperbolic geometry. At least the density of intersections with hyperboloids increases as one approaches light-cone boundary since the density of hyperboloids increases.

3. A tesselation of H^3 corresponds to the points $\{(asinh(\eta_n), \Omega_n)\}$. The lattice-like structure in $E^3$for $t = T$ would correspond to points (r_M, Ω) in $\{Ttanh(\eta_n), \Omega_n\}$. The difference from the representation hyperbolic geometry as H^3 is that instead of $r_M = asinh(\theta_n)$ for H^3 one has $r_M = Ttanh(\eta_n)$ for the analog of Poincare disk. For small values of η one has $sinh(\eta) \simeq \tanh(\eta)$ but not for large values so that E^3 is compressed to Poincare ball B^3.

   Neurons with large number of connections would correspond to points of tesselation with large values of η_n and similar neurons even if far away from each other would be mapped near to each other at spheres $\eta_n =$ constant surfaces (spheres for H^3 or circles for H^2).

   The discrete geometries for the magnetic image of neural sub-system as tesselations would naturally correspond to discrete subgroups of $G \subset SO(1,3)$ as analogs $G\backslash H^3$ of Platonic solids. As found, there is infinite number of them and concordance groups $\Gamma(N)$ ore of special interest. One obtains also their 2-D variants as 2-D planar slices consistent with the symmetries just like one can have 2-D lattices as sub-lattices of 3-D lattices in E^3.

   Remark: The elements of subgroup $G \subset SL(2, C)$ for given extension of rationals provide natural coordinates for the unit cells of tesselation, and can be used instead of $\{\eta_n, \Omega_n\}$.

4. The system could have a finite size due to finite light-velocity if it has resulted in an event analogous to Big Bang like event (TGD predicts a hierarchy of cosmologies within cosmologies and cd is geometrically analogous to Big Bang followed by Big Crunch). This option does not however look plausible at the level of visible bio-matter. At the level of MB this could be make sense and correspond to the emergence of a new onion-like layers to MB bringing in new scale of quantum coherence as CD.

   In the case of MB one can estimate the T from the assumption that EEG corresponds to communications between brain and particular layer of its MB. Schumann frequency 7.8 Hz corresponds to wavelength of $\lambda = 2\pi R_E$, R_E Earth radius. EEG alpha band is around 10 Hz and corresponds to a slightly shorter wave length lengths. If this frequency is realized as cyclotron frequency the corresponding part of MB should be of the order of Earth size. This would give $R \sim R_E$ and $T \leq R/c \leq .1$ s. The part of neuronal system considered could be the above described intersection corresponding to time $t = T$. After this no expansion would take place and the 3-D analog of Poincare ball would be preserved.

   Note that if MB would participate in cosmic expansion, one would expect that the frequency scale of EEG scales down like $1/a$, which is not observed. Different bands of EEG could however correspond to different values of $a = a_0$ defining different layers of MB.

The neuronal network has been assumed to be accompanied by flux tube network with flux tubes parallel to axons defining the "small" part of MB with size of order body size [**?**, **?**]. How the topology of this network correlates with the topology of the "large" part of MB with layers having size scales even larger than Earth size? Could the "small" networks at the level of biological body be representations of the "large" networks at the level of MB - or vice versa.

The higher level representations would re-organize the nodes of "small" flux tube networks by various criteria such as the number of connections to other nodes. Similar nodes - even distant ones - would correspond to points near to each other. Therefore similar neurons could be treated as coherent units with coherence induced from that at higher level. Synchronous firing would be the signature for nearness at the higher level. The hierarchy of layers of MB would perform basically classification of the objects of the system at the lowest level.

There is a huge number of possibilities for the cognitive representations corresponding to various values of N (in particular powers preferred prime p) labeling $\Gamma(N)$, to hierarchy of extensions of rationals and the values of T possibly identifiable as roots of polynomials defining representation of layer of MB in M^8. Therefore one can hope that this vision could provide universal view about the anatomy of MB in relation to that of biological body (in very general sense).

4.4.3 The interpretation of the hyperbolic tesselations of neurons in terms of ZEO, $M^8 - H$ duality, and cognitive representations

This picture suggests an interesting connection to TGD based view about quantum measurement theory [**?**], which actually extends physics to a theory of consciousness. Causal diamonds (CDs)

have a key role in ZEO and hyperbolic geometry is very naturally associated with them. The notions $M^8 - H$ duality [**?**, **?**] could provide an explanation for the special value $t = T$, and tesselations could correspond to a particular cognitive representation [**?**].

1. In zero energy ontology (ZEO) replacing ordinary ontology of quantum theory the notion of causal diamond (CD) plays a central role. CDs for a length scale hierarchy and CDs have sub-CDs. Space-time surfaces for given CD have ends at the upper and lower boundary of CD. In this picture the appearance of hyperbolic geometry at the level of MB would be very natural.

2. $M^8 - H$ duality [**?**] states that space-time surfaces could be regarded either as algebraic surfaces in M^8 or as preferred extremals of action in $H = M^4 \times CP_2$ reducing to minimal surface satisfying infinite number of additional conditions. Otherwise the consistency of dynamics in H dictated by partial differential equations with algebraic dynamics in M^8 dictated by algebraic equations would not be possible.

   One can say that space-time surfaces are roots of an octonionic polynomial obtained as an algebraic continuation of a real polynomial with rational coefficients to octonionic polynomial. This in the sense that either imaginary or real part of P in quaternionic sense vanishes and gives rise to 4-D surface in the generic case.

3. A special prediction of M^8 picture is that besides 4-D surfaces as roots of algebraic equations also 6-D special brane-like solutions with topology of 6-sphere S^6 are possible. For these solutions both real and imaginary parts vanish. These solutions have counterparts in H, and their intersection with cd is $t = r_n$ ball, where r_n is the root of P.

4. I have called the moments $t = r_n$ "very special moments in the life of self" identified as evolution of zero energy state of self by "small" state function reductions (SSFRs) as analogs of weak measurements. Also the size of CD increases in this process in statistical sense and corresponds to the increase of clock time as a natural correlate of subjective time defined by the sequence of SSFRs.

5. Could the state of neuron system at $t = T$ correspond to $T = r_n$ as a root of polynomial P? Could these special moments correspond to rapid jerks in the cosmological expansion so that also the development of living organism would involve a sequence of them increasing the value of Λ. Presumably these jerks would occur at the level of MB and possibly induce those at the level of biological body. At the level o MB they could also correspond to a phase transition like events in the evolution of consciousness involving scaling up the size of MB.

To summarize, the tesselations of H^3 or $E^1 \times H^2$ suggest a universal cognitive representations realized at the MB of the system. One would have hierarchy of p-adic length scales and extensions of rationals giving rise to hierarchies of tesselations defining cognitive representations at corresponding layers of MB. Living matter would be only a special case. In living matter EEG would define important hierarchies of tesselations but also other frequency ranges would do so.

4.5 Empirical support for MB as a carrier of information about state of BB

If the view about hyperbolic brain and body is true, an abstract plan of brain and BB would be realized at MB. There are several findings supporting this view and in the following two examples are described.

4.5.1 Salamander recovers after shuffling of its brain

In the lab, the neurons of the brain of a salamander were shuffled like a pack of cards. The salamander however recovered and preserved its memories (identified as learned behaviors) [J20]. In [K28, K17] this finding was considered as a support for the view that the brain is analogous to a hologram (TGD Universe can be seen as a conscious hologram [K2]). It seems, however, clear that a single neuron cannot represent the information content of the entire brain. However, if memories are represented by the images of neurons at the level of the MB, the shuffling of neurons has no

effect on memories as the experiment indeed demonstrated. Neurons would be analogous to RAM in computer science.

4.5.2 A chordate able to regrow all of its organs if dissected into three pieces

The popular article "Polycarpa mytiligera can regrow all of its organs if dissected into three pieces" `https://cutt.ly/SndWg8l` tells about an extraordinary biological discovery.

The creature known as Polycarpa mytiligera is a marine animal commonly found in Gulf of Eilat that is capable of regenerating its organs. The surprising discovery was that the animal can regenerate all of its organs even when dissected into three fragments.

Such a high regenerative capacity has not been detected earlier in a chordate animal that reproduces only by sexual reproduction. In the experiment, the researchers dissected specimens in a method that left part of the body without a nerve center, heart, and part of the digestive system. Not only did each part of the creature survive the dissection on its own, all of the organs regenerated in each of the three sections.

This is highly interesting challenge for TGD. The information about the full animal body was needed for a full generation. How it was preserved in dissection? Was genetic information, as it is understood in standard biology, really enough to achieve this?

1. In TGD inspired quantum biology magnetic body (MB) carrying dark matter as $h_{eff}/h_0 = n$ phases is the key notion. h_{eff} is an effective Planck constant defining the scale of quantum coherence. n is dimension of extension of rationals defined by a polynomial defining space-time region, and serves as a measure for algebraic complexity and serves as a kind of IQ. MB with high IQ defined by n serves as the master of BB controlling it and receiving information from it. The layers of MB also define abstracted representations of BB.

2. If BB suffers damage, the information about BB is not lost at MB and MB, which carries abstracted representations about BB and able to control BB, could restore BB partially. Healing of wounds would be the basic example. A more dramatic example about healing was discovered by Peoch: the neurons of the salamander brain can be shuffled like cards in a package but the animal recovers.

   Indeed, since nothing happens to the MB of salamander or Polycarpa Mytilera, recovery is in principle possible. The new finding gives additional support for MB as a carrier of the biological information.

One can also make questions about the recovery process itself. Could recovery be seen as a self-organization process of some kind?

1. In the TGD framework, quantum measurement theory relies onzero energy ontology (ZEO) and solves its basic problem. The basic prediction is that in the TGD counterparts of ordinary state function reductions ("big" SFRs or BSFRs) time reversal takes place. In small SFRs (SSFRs) identifiable as analogs of "weak" measurements, the arrow of time is preserved. ZEO makes it also possible to understand why the Universe looks classical in all scales although BSFRs occur in all scales at the dark onion-like layers of MB controlling the lower layers with ordinary biomatter at the bottom of the hierarchy.

2. Time reversed dissipation after BSFR looks like self-organization from the perspective of the outsider with a standard arrow of time, called it briefly O, and would bea basic self-organization process in living systems. In dissipation gradients disappear but in time-reversed dissipation they appear from the perspective of O.

3. This makes possible also self-organized quantum criticality (SOQC), which is impossible in standard thermodynamics because criticality by definition means instability. The change of the arrow of time changes the situation from the perspective of O since the time reversed system tends to approach the criticality. Homeostasis would rely SOQC rather than on extremely complex deterministic control programs as in the computerism based picture. Change the arrow of time for a subsystem and let it happen. Very Buddhist approach to healing!

4. The change of the arrow of time would be also central in the healing processes and also regeneration.

5 DMT experiences and hyperbolic geometry

I received a link to a highly inspiring talk about a modelling of DMT induced experiences in terms of 2-D and more generally 3-D hyperbolic geometry. The title of the talk (see `https://zpr.io/7Bzbagjrk7LE`) was "DMT and Hyperbolic Geometry"". The talk was by a person using the name "Algekalipso" and I understand that the person in question is Andres Gomez Emilsson. The organization in question is Qualia Research Institute (`https://cutt.ly/fGO5D9W`). There is also article by Emilssson (`https://cutt.ly/YGO5Qrk`) with essentially the same content.

5.1 Can one characterize DMT experiences by using temperature like parameters

The question posed in the beginning of the talk was whether there could exist parameters analogous to temperature allowing a general qualitative understanding of the nature of the DMT and more general psychedelic experiences. The proposal was that the DMT experience could be characterized by two parameters.

1. The first parameter characterizes how "hyperbolic" the visual field is and is identifiable as the curvature of the hyperbolic space. The idea is that during a DMT trip the experienced 3-space is not Euclidean but hyperbolic. This kind of geometry has been proposed as an effective statistical geometry of the brain in which functionally similar neurons distant from each other are close to each other [**?**].

   In the TGD framework, this effective geometry could correspond to a real hyperbolic geometry of 3-D hyperbolic space playing a key role in TGD and assignable naturally to the magnetic body (MB).Besides ordinary visual input also the projection of objects of H^3 to the usual Euclidean space E^3 would be experienced so that the experience would be "multiverse" experience.

   In the TGD Universe, the space-times are minimal surfaces apart from singularities analogous to frames of soap films [**?**] and their basic aspect is local saddle point property possessed also by hyperbolic spaces. Maybe DMT experiences make it possible to visually perceive 3-surfaces as objects in H^3. Also the usual vision corresponds to hyperbolic vision but with a small value of the H^3 curvature.

2. The second parameter would characterize the complexity of the experience and could in the TGD framework correspond to algebraic complexity associated with the extension of rationals determined by the polynomial determining a given space-time region by $M^8 - H$ duality [**?**, **?**].

   The value $h_{eff} = nh_0$ of the effective Planck constant, which can be larger than h, would correspond to the dimension n of the extension of rationals and serve as a universal IQ. Dark matter would correspond to phases of ordinary matter with $h_{eff} \neq h$.

   As the IQ increases, the experience transforms from simple to complex and eventually chaotic since the experiencer is not able to make sense of it. Under some assumptions this would relate to the formation of Julia set type fractals.

The model also leads to a progress in the interpretation of TGD. In particular, a geometric interpretation of p-adic length scale hypothesis [K29, K13] suggesting that p-adic length scale is accompanied by much shorter length scale of order CP_2 length scale finds an interpretation: p-adic length scale would correspond to the Euclidian scale defined by a hyperbolic length scale naturally emerging for hyperbolic tessellations.

5.2 TGD based model for DMT experiences

I have already earlier developed a TGD based model [**?**] for the finding that the brain seems to obey an effective statistical geometry which is hyperbolic in the sense that neurons which are functionally near to each other have a short distance in this geometry. In the sequel a TGD based model for DMT experiences relying on hyperbolic geometry and based on the ideas already outlined is developed.

5.2.1 About hyperbolic spaces

First some mathematical background.

1. Hyperbolic 3-space H^3 is a generalization of 1-D hyperbola of 2-D space-time as a curve defined by condition $t^2 - x^2 = a^2$ but with its metric being induced from the 2-D Minkowski metric $ds^2 = dt^2 - dx^2$. By performing all possible rotations of this 1-D hyperbola one obtains H^3.

2. In particle physics H^3 corresponds to mass shell $E^2 - p^2 = m^2$ and in cosmology to cosmic time identifiable as $a^2 = t^r - r^2$ in $M^4 \subset M^4 \times CP_2$. a defines Lorentz invariant cosmic time and is therefore analogous to absolute time invariant under Lorentz boosts which do not affect the tip of the light-cone. It is not invariant under translations however.

   In the TGD framework H^3 has a central role and plays a key role also in the model of the brain involving the notion of magnetic body (MB). One could say that cognitive and sensory representations are realized at the intersection of MB with H^3.

3. The value of cosmic time a characterizes the curvature of H^3. The curvature is proportional to $1/a^2$ and the smaller the value of a, the larger the curvature and "hyperbolicity". As a decreases, one approaches the analog of the Big Bang with infinite curvature. As a increases, one approaches flat E^3 in an infinite future. Cosmic evolution proceeds from the Big Bang to the future whereas DMT trip would be a travel towards the moment of Big Bang. One can of course ask whether trips could also be in the opposite time direction.

4. The lecture (see also the written version) contains a nice description of hyperbolic geometry. In particular, the volume of a ball in H^3 increases exponentially as a function of its radius and this means that H^3 has a lot of volume. This might be very relevant for memory storage. This can be easily understood from the visualization in terms of real hyperboloid.

5. The counterpart of plane E^2 of E^3 in H^3 is 2-D hyperbolic space H^2 and Poincare sphere gives a good view about what the projections of the tesselations of H^2 look like when projected to E^2. The radial size for the basic unit of tessellations decreases with the distance from the origin whereas the region around the origin looks like E^2.

   Note that one particular tessellation, known as icosa-tetrahedral tessellation, plays a key role in the TGD based view about genetic code implied by the notion of bioharmony [**?**], which relies on icosahedral and tetrahedral Hamiltonian cycles [**?**].

6. The hyperbolic geometry H^2 embedded locally in E^3 has the saddle property meaning that in one direction the observer is at the bottom of the valley and in another direction at the top of the hill. This property has analog also at the level of abstract geometry: geodesic lines diverge very rapidly since the curvature scalar is negative: for spheres they converge.

7. By their negative curvature, H^3 and H^2 allow tessellations (analogs of lattices in E^3 and E^2) which are not possible in E^3. For instance. 7-polygons are possible. The number of tessellations is infinite whereas in E^2 only 17 wall papers are possible.

8. Hyperbolic analogs of plants are mentioned as fractals.

5.2.2 A possible interpretation of DMT experiences

DMT experiences could reflect both the relationship between the geometries of hyperbolic 3-space and Euclidian 3-space represented as 3-surfaces of Minkowski space and the algebraic complexity assignable to the tesselations of H^3.

1. DMT trip as travel backwards in cosmic time

It was already mentioned that the proper time parameter a and algebraic complexity characterized by extension of rationals could characterize DMT experience. The increased complexity in turn means approach to apparent chaos since it is not possible to comprehend too high complexity. The following description is what I understood from the representation of Emilsson. I have not personally made DMT trips except spontaneously decades ago. This experience was so impressive that I got a passion to understand conscious experience from a quantum physics point of view.

1. For small DMT does, the visual experiences correspond to patterns in plane $E^2 \subset E^3$, which can be regarded as plane $H^2 \subset H^3$ for large value of a and thus small curvature.

   The lattives of E^2 (17) called wallpapers serve as a background for the visual field. As if one would be perceiving two different worlds simultaneously. The lattices can be dynamical and pulsate. This kind of experience was part of the "Great Experience" decades ago.

2. As the DMT dose increases, the value of a decreases and one moves towards the Big Bang, so to say. In TGD and TGD inspired theory of consciousness, causal diamonds (CDs), identified as intersections of future and past directed light-cones, could be seen as correlates of perceptive fields [**?**, **?**] which in TGD are 4-D so that also memories could be seen as analogs of sensory perceptions. CD is analogous to a Big Bang followed by a Big crunch. The CDs form a fractal hierarchy.

   The visual field becomes more and more hyperbolic. What we would see is the projection of the patterns of $H^2_a \subset H^3_a \subset M^4_+$ to $E^2_t \subset E^3_t \subset M^4_+$, where a is cosmic time and t is the linear Minkowski time.

3. At the next step the 2-D patterns in H^3 are replaced by patterns in H^3 as hyperbolic analogous of curved surfaces in E^3 and one can say that the dimension of the visual field becomes 3.

4. In TGD Universe space-time surfaces are minimal surfaces [**?**] and analogous to 4-D soap films spanned by frames appearing as singularities where minimal surface property and also the determinism of field equations fail so that the frames are space-time correlates as seats of non-determinism. The saddle property of minimal surface could explain the appearance of the "hyperbolic plants" which Emilsson lists as part of DMT experience.

Do we really see a hyperbolic world or does the visual perception reflect only the statistical geometry of the brain? The TGD proposal is that these two views reflect real space-time surfaces. One can of course argue that since conscious experience itself is associated with quantum jumps in the TGD framework so that the experience is about becoming rather than about being in the physical sense.

2. Algebraic complexity of the experience as a second parameter

The second parameter discussed in the talk was meant to characterize what was called valence as a measure for the "degree of bliss" of the experience. TGD counterpart would be algebraic complexity associated with the extension of rationals defined by the polynomial defining the space-time region. The value of $h_{eff}/h_0 = n$ as dimension of extension would serve as the parameter [**?**, **?**] For large values of n the situation becomes too complex to comprehend or remember and the bliss is lost.

In the TGD framework more complex systems can be engineered as functional composites of polynomials and this leads to the increase of h_{eff}. One can interpret this also as a construction of many-particle states with each polynomial, which represents a particle-like entity. When a fixed polynomial is iterated functionally, one obtains a fractal known as Julia set so that the connection with fractals is quite concrete [**?**, **?**, **?**].

To sum up, the reports of Emilsson suggest a very concrete connection between DMT experience and TGD based views of space-time and number theoretical vision about quantum theory explaining dark matter as $h_{eff} = nh_0$ phases. DMT perception would be perceptions of both ordinary and dark matter simultaneously.

5.3 Possible implications for the interpretation of TGD

The proposed picture involving in an essential manner both H^3 and E^3 suggests some highly non-trivial implications concerning the physical interpretation of TGD.

5.3.1 H^3 is ideal for information storage and holography

The hyperbolic radial distance r_H in H^3 from origin is given by $r_H = aarsinh(r_E/a) \simeq alog(r_E/a)$, where r_E is the Euclidean distance in E^3. r_H depends logarithmically of r_E slowly. The area $S = 4\pi a^2 r^2$ of the hyperbolic sphere of radius u projected to Euclidean sphere with r increases as function of u as $S \simeq 4\pi a^2 exp(2u/a)$. One can imbed a tree graph (say) m ranches in the node much more effectively than in the Euclidean case. One can think of the tree graphs a simple model for a neural network consisting of layers such that n:th layer has m^n nodes for

If a given node requires fixed area ΔS, the solid angle $\Delta\Omega$ required by a node decreases as $1/r^2$ whereas in E^3 it remains constant, the number of these areas at sphere increases as $S/\Delta S = 4\pi exp(2u/a)/\Delta S$. In the Euclidean case it increases as $S/ = 4\pi r^2/\Delta S$. This means that the geometric information storage capacity ofH^3 is exponentially larger. Therefore the idea that the 3 surfaces associated with H^3_a could serve as information storage is very attractive.

5.3.2 H^3 and the origin of p-adic length scale hypothesis

p-Adic prime assignable to a region of the space-time surface is identified as the largests ramified prime associated with the polynomial defining the region of the space-time surface. p-Adic length scale hypothesis states that the physical preferred p-adic primes correspond to p-adic primes $p \simeq m^k$, where m is a small integer: $m = 2$ is the most important case.

I have proposed that there are two scales involved. The small p-adic length scale associated with m and the exponentially larger p-adic length scale proportional to $\sqrt{p}$. The origin of these scales has remained a mystery.

Could the small scales correspond to the radial scales r_H and large scales to radial scales r_E?

1. H_3 allows tessellations playing a key role in TGD framework and the size scale of the cell of the tesselation defines a natural length scale unit $\Delta r_H = aX$, which could define the small scale and scales would be expressible in terms of this unit.

2. In E^3 the natural scale would correspond to Euclidean lattices with constant cell size Δr_E. For $r_H = \Delta r_H$, $r_E = asinh(r_H/a) \simeq aexp(r_H/a)$ would give $r_E \simeq aexp(nX = am^{\Delta X/log(m)}$.

3. $r_E = L_p = \sqrt{p}R$ would give $\sqrt{p}R = am^{\Delta r_H log(a)/alog(m)}$. p-Adic length scale hypothesis $p \simeq m^k$ requires $X = klog(m)/2log(a/R)$.

   Note that there would be a logarithmic dependence of the p-adic length scale on the a, which would have an interpretation as a renormalization of the p-adic length- and mass scales.

6 Support for the magnetic densory canvas hypothesis

Magnetic sensory canvas hypothesis is certainly the craziest idea inspired by TGD inspired theory of consciousness. The effects of Lithium on brain function lend support for the notion of magnetic body. The effects of atmospheric and magnetospheric electromagnetic phenomena to conscious experience would also support the sensory canvas hypothesis. If sensory organs are the seats of primary sensory qualia, the possibility that atmospheric phenomena could induce extrasensory percepts is excluded. Sensory percepts based on back-projection mechanism might be however possible. Taos hum is a strange anomaly which might also relate to the magnetic body and dark matter at it.

6.1 Invisible magnetic fields as a support for the notion of monopole flux tube

Physicists studying a system consisting of a layered structure consisting of alternate superconducting and spin liquid layers have found evidence for what they call invisible magnetic fields. The popular article is published in Scitechdaily (`https://cutt.ly/XVme0Xj`) and tells about research carried out by Prof. Beena Kalisky and doctoral student Eylon Persky in Bar-Ilan University. The research article is published in Nature [**?**] (`https://cutt.ly/wVme7pu`).

First some basic notions.

1. The notions of spin liquid and charge-spin separation are needed. Popular texts describe charge separation in a way completely incomprehensible for both layman and professional. Somehow the electron would split into two parts corresponding to its spin and charge. The non-popular definition is clear and understandable. Instead of a single electron, one considers a spin liquid as a many-electron system associated with a lattice-like structure formed by atoms. The neighboring electrons are paired. There are a very large number of possible pairings. In the ground state the spins of electrons of all pairs could be either opposite or parallel (magnetization). Pairing with a vanishing spin is favoured by Fermi statistics.

   If the opposite spins of a single pair become parallel and this state is delocalized, one can have a propagating spin wave without moving charge. If one electron pair is removed and this hole pair is delocalized ,one obtains a moving charge +2e without any motion of spin.

2. When a superconductor of type II is in an external magnetic field with a strength above critical value, the magnetic field penetrates to the superconductor as vortices. Inside these vortices the superconductivity is broken and electrons swirl around the magnetic field. This is how the magnetic flux quanta become visible.

In the layered structures formed by atomic layers of spin liquid and superconductor, magnetic vortices are created spontaneously in the superconducting layers. In the Maxwellian world, magnetic fields would be created either by rotating currents or by magnetization requiring a lattice-like structure of parallel electron spins. In the recent case spontaneous magnetization should serve as a signature for the presence of these magnetic fields.

Surprisingly, no magnetization was observed so that one can talk of "invisible" magnetic field.

In the bilayered structure 4Hb-TaS_2, the superconductivity is anomalous in the sense that the critical temperature is 2.7 K whereas in bulk superconductor 2H-TaS_2 it is .7 K. There is also a breaking of time reversal symmetry closely related t the presence of the magnetic flux quanta. The magnetic flux quanta survive above critical temperature 2.7 K up to 3.6 K and their life time is very long as compared to the electronic time scales (12 minute scale is mentioned). Therefore one can talk of magnetic memory.

The proposal is that a spin liquid state known as a chiral spin liquid is created and that the invisible magnetic field associated with the chiral spin liquid penetrates to the superconductor as flux quanta.

Could TGD explain the invisible magnetic fields?

1. TGD predicts what I called monopole flux tubes, which have closed, rather than disk-like , 2-D cross sections and carry monopole flux requiring no current nor magnetization to generate it.

   This is possible only in the TGD space-time, which corresponds to a 4-surface in 8-D space $H = M^4 \times CP_2$, but not in Minkowski space or in general relativistic space-time in its standard form. The reason is that the topology of the space-time surface is non-trivial in all scales.

   The possibility of closed monopole flux tubes without magnetic monopoles, is one of the basic differences between TGD and Maxwell's theory and reflects the non-trivial homology of CP_2.

2. Monopole flux tubes solve the mystery of why there are magnetic fields in cosmic length scales and why the Earth's magnetic field B_E has not disappeared long ago by dissipation [**?**].

3. Electromagnetic fields at frequencies in the EEG range corresponding to cyclotron frequencies have quantal looking effects on brains of mammalians at the level of both physiology and behavior. The photon energies involved are extremely low.

   In the TGD based quantum biology they can be understood in terms of cyclotron transitions for "dark" ions with a very large effective Planck constant $h_{eff} = nh_0$ in a magnetic field of .2 Gauss, which is about 2/5 of the nominal value .5 Gauss of the Earth's magnetic field B_D. The proposal is that B_E involves a monopole flux contribution about $2B_E/5$ [K11].

   The estimate for the invisible magnetic field was .1 Gauss so that the numbers fit nicely.

The findings suggest that the spin liquid phase atomic layer involves the monopole flux tubes assignable to the Earth's magnetic field and orthogonal to the layer. They would not be present in the superconducting layer but would penetrate from spin liquid to the superconductor.

6.2 Lithium And Brain

My friend Samppa told about positive effects of lithium on brain. I have proposed years ago that these effects could be explained by cyclotron frequency hypothesis and I decided to search for web about the recent situation. Lithium has been used for more than 50 years as a mood stabilizer in manic depression. During last years Lithium has been studied intensively and found that it can be used also in treatment of schizophrenia and many other brain disorders. The popular and somewhat hypeish article "Lithium promotes longevity-mood and love" at `http://tinyurl.com/ns9ksms` tells about various applications of lithium. Even statistical evidence that lithium reduces violent crime is represented.

6.2.1 Basic findings

To my view the importance of these apparently rather specific effect is that it lends support for the notion of magnetic body.

1. Lithium is found to increase the volume of grey matter (see the artcle "Lithium-induced increase in human brain grey matter" at `http://tinyurl.com/gu2s4ps`) and it is accumulated in white matter (axons) (see the article "Lithium in brain" at `http://tinyurl.com/zm9a4gm`). Lithium also enhances axonal growth and myelinination.

2. The higher concentration of lithium in drinking water is found to reduce mortality and suicide rate. It has been also found that higher lithium concentration increases the life span of bacteria (see `http://tinyurl.com/z73ayq4`).

3. Lithium might also help in Altzheimer's disease and other neurodegenerative diseases such as Parkinson's and Huntington's disease. Lithium is found to inhibit neuro-atoptosis (death of neurons). Lithium's neuroprotection may result from its inhibition of protein GSK3, which in turn prevents neuroatoptosis regulating survival and differentiation.

4. Lithium is found to increase neurogenesis helping the healing of brain injuries (see artcle "Inactivation of Glycogen Synthase Kinase 3 Promotes Axonal Growth and Recovery in the CNS" at `http://tinyurl.com/hlfbkvz`). Lithium has also positive effect on memory. Lithium affects various signalling proteins and pathways. Indeed, lithium has been claimed to serve as "brain food" (see `http://tinyurl.com/zhe5ckf`).

5. Disruption in the blood-brain barrier is proposed to be a missing link between brain and body flammation in bipolar disorder [J15] (see `http://tinyurl.com/ya9tqzj8`). According to the abstract of the article:

   The blood-brain barrier (BBB) regulates the transport of micro- and macromolecules between the peripheral blood and the central nervous system (CNS) in order to maintain optimal levels of essential nutrients and neurotransmitters in the brain. In addition, the BBB plays a critical role protecting the CNS against neurotoxins. There has been growing evidence that BBB disruption is associated with brain inflammatory conditions such as Alzheimer's disease and multiple sclerosis. Considering the increasing role of inflammation and oxidative stress

in the pathophysiology of bipolar disorder (BD), here we propose a novel model wherein transient or persistent disruption of BBB integrity is associated with decreased CNS protection and increased permeability of proinflammatory (e.g., cytokines, reactive oxygen species) substances from the peripheral blood into the brain. These events would trigger the activation of microglial cells and promote localized damage to oligodendrocytes and the myelin sheath, ultimately compromising myelination and the integrity of neural circuits. The potential implications for research in this area and directions for future studies are discussed.

The mechanism of lithium-brain interaction is still unknown: mechanisms like altered mitochondrial function, inflammation, dysregulated dopaminegic/glutamatergic systems have been proposed. It is said that lithium helps to cure multisystem disorder rather than disease (reader can try to figure out what this might mean!). In any case, the effect of lithium seems to be on gene expression and it would seem that lithium only makes possible natural healing mechanisms to operate rather than providing single healing mechanism.

6.2.2 TGD view about Lithium's role

In TGD framework organism-environment pair of standard biology is replaced with the triplet magnetic body - organism -environment [K28, K27, K26]. Magnetic body uses biological body as sensory receptor and motor instrument. This suggests that the re-establishment of communications of brain with some level of the magnetic body is how lithium causes its positive effects. The disorders caused by the lack Lithium and other biologically important ions would be something totally new from the perspective of standard neuroscience. The standard idea that some kind of neuronal receptors or some information molecules are underpresented or over-represented would not be enough. Magnetic body would take care of healing in much more effective manner than more or less random tinkering of bio-molecular concentrations.

1. The basic hypothesis is that communications between biological body and magnetic body correspond to sending sensory input from the cell membrane to magnetic body as generalized Josephson radiation and receiving control command from magnetic body controlling gene expression as cyclotron radiation [K16, K17, K7].

   The control commands from magnetic body would rely on signals having carrier waves with cyclotron frequencies associated with dark variants of biologically important ions and assignable to dark magnetic bodies forming an onionlike scale hierarchy with sizes of order cyclotron frequency in endogenous magnetic field $B = 2B_E/5$, where $B_E = .5$ Gauss is the nominal value of the Earth's magnetic field. The size scale assignable to 10 Hz frequency would be of order Earth size.

   The sensory communications to magnetic body from cell membrane based on generalized Josephson frequencies associated with cell membrane regarded as generalized Josephson junction. The frequencies of radiated dark photons would be differences of cyclotron frequencies at the two sides of the junction plus relatively small contribution corresponding to the ordinary Josephson frequency determined by the membrane potential. Nerve pulse activity would thus induce frequency modulations of the carrier wave: kind of whale's song (or human speech) would be in question. Also amplitude modulation and even modulation of the polarization of radiation can be considered.

   The value of Planck constant is large and EEG frequencies correspond to energies in the energy range of biophotons assumed to result in the transformation of dark photons to ordinary ones visible and UV photons. These energies correspond to excitation energies of biomolecules so that magnetic body could induce chemical reactions.

   The gravitational Planck constant $\hbar_{gr} = GMm/v_0$ (here M and m denote masses connected by magnetic flux tubes carrying dark gravitons and $v_0/c < 1$ defines a velocity parameter - some natural velocity in the system) introduced originally by Nottale [E2] is identified with the effective Planck constant $h_{eff} = n \times h$ emerging in TGD framework from the fractal hierarchy of isomorphic sub-algebras of super-conformal algebras of various kinds (generalizations of ordinary conformal algebras) serving as symmetries of quantum TGD [K31].

If M corresponds to large central mass and m to a mass of charged particle (elementary particle, ion, molecular ion,..), one obtains that cyclotron energies proportional to h_{eff}/m do not depend on mass number at all so that cyclotron energy spectrum is universal (and corresponds to that of bio-photons in visible and UV where also molecular transition energies are). The additional prediction is that each charged dark particle is at its "personal" dark magnetic flux tube. Instead of being a random chemical soup, dark living matter is highly organized, somewhat like library containing each book at its own self! It is difficult to exaggerate the importances of this implication.

2. The most important biologically important ions include H^+, Li^+, Na^+, Cl^-, K^+, Ca^{++}, Mg^{++}. If some of these ions are absent, the communications to the corresponding layer of the magnetic are not possible and this part of magnetic body cannot control the corresponding parts of brain. The generation of these ions could be based on charge separation causing also the formation of exclusion zones (EZs) of Pollack [I1] as protons are transformed to dark protons at dark flux tubes outside EZ.

   It is known that lithium ions accompanying lithium carbonate Li_2CO_3 dose intefere with ion transport processes (sodium pump) pumping Na^+ ions from cell interior (see `http://tinyurl.com/y9u4uorr`). This suggests that also Li ions give rise to dark generalized Josephson currents through the cell membrane.

3. Electron corresponds to 6×10^5 Hz, proton to 300 Hz, and lithium cyclotron frequency is 50 Hz and could be assigned to the limbic brain. Mg^{++} corresponds to 26 Hz, Ca^{++} to 15 Hz, Na^+ to 13 Hz, Cl^- to 8.5 Hz, K^+ to 7.5 Hz, etc... Iron and Cobolt would have cyclotron frequencies near 10 Hz of alpha band. The cyclotron frequencies for ^{6}Li and ^{7}Li are 50 Hz and 43 Hz.

   Also higher harmonics of cyclotron frequencies are present and I have proposed that the magnetic field strength has spectrum, which corresponds apart from scaling to the frequency spectrum of biophotons, so that this picture is oversimplified. For instance, in retina 80 Hz frequency appears and would require stronger magnetic field unless it corresponds to higher harmonic.

4. Magnetic fields oscillating at 50 Hz frequency are known to have biological effects [K16]. The size of the corresponding magnetic body part would be obtained from the wavelength $\lambda = 2\pi R$ (R denotes the radius of Earth) of the lowest Schumann frequency 7.8 Hz as $L = (7.8/50) \times R = .98 \times R$. This suggests that dark magnetic flux tubes assignable with Earth are involved: not however that the field strength is $2B_E/5$.

   Quite recently (towards end of 2016) I learned that in 1986, scientists at Cornell University examined the effects of the two isotopes of Lithium on the behavior of rats (see `http://tinyurl.com/zyy3b4l`). Pregnant rats were separated into three groups: One group was given lithium-7, one group was given the isotope lithium-6, and the third served as the control group. Once the pups were born, the mother rats that received lithium-6 showed much stronger maternal behaviors, such as grooming, nursing and nest-building, than the rats in either the lithium-7 or control groups.

   The naïve guess is that EEG amplitude at 50 Hz is enhanced thanks to ^{6}Li dose. It is found that the increase of lithium carbonate level for patients increases EEG delta and theta intensities and slow down alpha frequency (see `http://tinyurl.com/z88okg7`): unfortunately there is no mention about 50 Hz. The simplest interpretation is that improved communications at 50 Hz induce healing and indirectly improve communications also at lower frequencies. The slow down of alpha frequency remains to be understood. The precise values of cyclotron frequencies are controlled by magnetic body by varying flux tube thickness (flux quantization and conservation implies correlation of field strength with the thickness of the flux tube). Typical variation is about 10 per cent.

5. A naïve dimensional guess is that the size scale of the part of the magnetic body corresponding to particular part of brain is proportional to its size. The naïve scaling argument would suggests that lithium scale is few centimeters. One must of course take this kind of estimates with extreme caution. The most primitive parts of CNS such as spinal chord and brain stem

would correspond to highest frequencies in EEG and also above it, and the most advanced parts such as cortex or its sub-structures to the lowest frequencies such as at 10 Hz alpha frequency: lower frequencies would not correlate directly with our conscious experience but could correspond to large structures giving rise to collective levels of consciousness.

To sum up, lithium could help by re-establishing the connection to the lithium part of the magnetic body so that it could fix the part of brain involved. This would take place by control commands controlling gene expression.

6.2.3 50 Hz electric oscillation wakes up brain

Thanks for Ashton Martin for very interesting link (`http://tinyurl.com/wfbooaq`) related to neuroscience. The popular article tells about the work of Michelle Redinbaugh *et al* [J9] (`http://tinyurl.com/uwfvatr`). The researchers have conducted experiment on monkeys in anaesthesia and conclude that the activation of central lateral thalamus by 50 Hz electric oscillations may enable consciousness. Activation of the central lateral thalamus and deep layers of the cerebral cortex drives pathways in the brain that carry information between the parietal and frontal lobe in the brain, the study suggests.

From TGD point view the conclusion is too far fetched and reflects the naïve "consciousness-module" thinking. The fining is however very interesting from the view point of TGD inspired theory of consciousness and quantum biology.

1. The wakeup from anaesthesia happened using 50 Hz electric stimulation of central lateral thalamus.

2. In TGD framework magnetic body (MB) carries dark matter as phases of ordinary matter with effective Planck constant $h_{eff} = n \times h_0$, which can be very large. n serves as a kind of IQ and MB serves as a master using biological body (BB) - in particular brain - as slave. EEG and it scale variants serve as a tool for communication to and control by MB. EEG photons are dark with large h_{eff} and can transform to bio-photons in visible and UV energy range and thus affect molecular transitions.

3. MB has layered structure with cyclotron frequencies of biologically important ions associated with the control by MB in "endogenous" magnetic field $B_{end} = .2$ Gauss identifiable as monopole flux part of Earth's magnetic field with nominal value $B_E = .5$ Gauss. B_{end} explains the findings of Blackman and others about the effects of ELF radiation on brain and also why EEG correlates with consciousness and brain state. Without MB sending of EEG radiation to outer space would be horrible waste of energy resources.

4. For ^{7}Li the cyclotron frequency for B_{end} is 50 Hz. Litium is known to have healing effect on depression and heal axonal infection. Depression and other problems could be due to the lack of communications to MB or control by MB. This would be due to a lack of magnetic flux tubes containing cyclotron B-E condensate of biologically important ions. MB could not take care of BB.

5. Interestingly, the rate of lightnings in Earth's atmosphere is 50 Hz (`http://tinyurl.com/rb2l737`) and corresponds to a very strong peak in the em resonance spectrum of Earth including also Schumann resonances at 7.8, 14, 20, 26, 33, 39, 45 and 59 Hz (`http://tinyurl.com/r2dge5y`). TGD inspired theory of consciousness predicting self hierarchy and that the MB of Earth - Magnetic Mother Gaia - is also a conscious entity, suggests a connection.

6. The finding suggests that some layer of MB of thalamus region producing dark cyclotron radiation at cyclotron frequency of Li manages to wake up this brain region in presence of irradiation. How?

   (a) The model of water memory based on MB and water as a poly-phase involving dark magnetic flux tubes with $h_{eff} = n \times h_0$ suggests that 50 Hz frequency generates in water flux tubes with cyclotron frequency of 50 Hz which act as receiving and sending antennas.

(b) Water would detect this frequency by tuning the thickness of the flux tubes to tune cyclotron frequency to 50 Hz: this is possible for monopole flux tubes not allowed by Maxwellian ED: flux is conserved and changing the thickness changes the cyclotron frequency. The antennas can send and receive 50 Hz radiation. The 50 Hz antennae generated by oscillation em field would be able to receive the cyclotron radiation from MB and wake up.

(c) The flux tubes can also tune to the cyclotron frequencies associated with the MBs of invader molecules and this would make possible to generate "fake" molecules as MBs of water clusters. This would explain water memory, and give rise to basic recognition mechanism of immune system. Also homeopathy would be real effect and be based on the build-up of "fake" variants of molecules as flux tube antennae tuned to cyclotron frequency spectrum of MB of molecule. This requires metabolic energy feed to increase the value of h_{eff} at magnetic flux tubes and the agitation of water would provide this energy.

Magnetic sensory canvas hypothesis is certainly the craziest idea inspired by TGD inspired theory of consciousness. The effects of atmospheric and magnetospheric electromagnetic phenomena to conscious experience would support the sensory canvas hypothesis. If sensory organs are the seats of primary sensory qualia, the possibility that atmospheric phenomena could induce extrasensory percepts is excluded. Sensory percepts based on back-projection mechanism might be however possible.

6.3 Atmospheric And Ionospheric Phenomena And Sensory Canvas Hypothesis

The sounds claimed to be generated by auroras and meteors and the correlation of UFO reports and ET experiences with tectonic activity provide some clues in the attempt to develop magnetic sensory canvas hypothesis. Also various anomalous visual percepts and OBE experiences provide challenges for the model.

6.3.1 The sounds generated by auroras

There are claims that auroras generate audible sounds [F3] (for the quantum model of auroras see [K3]). These sounds have not been detected by acoustic means. Of course, it might be only a matter of time when this is done.

A particular example of microwave hearing [I5] could be in question. The microwave MEs generated in auroras could propagate like massless particles along ELF MEs to brain, and induce cortical perturbations modulated by ELF frequencies serving as modulating frequencies and determining the pitch of the sounds heard. The perturbations would be analogous to electric stimulation of cortex inducing sensory percepts by back-projection mechanism. The cortical perturbations would generate auditory sensations by the back-projection mechanism. Higher Schumann resonances are in the audible range and could also be mediated along the flux tubes from the magnetic body or magnetosphere to brain and induce audible sounds by the back-projection mechanism.

The TGD based model of hearing relies heavily on classical Z^0 fields and auditory canvas could be actually Z^0 magnetic. Since all classical fields are expressible in terms of CP_2 coordinates, magnetic storms are expected to be accompanied by their Z^0 magnetic counterparts.

6.3.2 The sounds generated by meteors

so some further evidence for the sensory canvas hypothesis. Since 16th century it is known that also meteors produce audible sounds. What is mysterious that there is no time lag due to the propagation through the atmosphere. The explanation is that it is very low frequency em waves which propagate to Earth and generate sounds by interacting with the objects at the surface of Earth. Joined by the International Leonid Watch - Croatia (ILWC) project, a group of scientists presented the first instrumental detection of elusive electrophonic meteor sounds. In November 1998, the researchers from the Croatian Physical Society and the University of Kentucky organized

an expedition to Mongolia to observe the anticipated Leonid meteor shower and shed some light on the phenomenon [F2].

The complete data analysis revealed two electrophonic sounds that provided several important clues about the nature of this longstanding astronomical mystery. It became clear that sounds were created when the meteors were crossing night-time ionosphere (the heights involved are in 85-110 km). The electrophonic sounds seem to be produced inside the measuring apparatus suggesting that electromagnetic energy is transformed to sound at this stage. The existing theories cannot however completely explain the phenomenon. The energy of the meteor does not seem to be high enough to invoke the electric fields needed to explain the electronically recorded sounds: only one percent of the electric energy is estimated to be transformable to acoustic form but the required conversion ratio seems to be 100 percent and perhaps even higher than this. The frequencies are much lower than the expected range 20-20.000 Hz range for sferics, which by the way is the range of audible sounds, not an accident in TGD universe. The fundamental frequencies are in the region 37-44 Hz but are consistent with the psychophysical correlate of the sound (deep "pop").

Magnetic mirrors as carriers of the electromagnetic perturbations might allow a better understanding of the phenomenon. What is intriguing that the frequencies are in the range 37-44 Hz: this frequency range is the same as associated with the average value of the thalamocortical resonance frequency of 40 Hz. This frequency range should be associated with the sensory representations on the magnetic canvas. It is known that sounds near 40 Hz induce strong effect in EEG. The first hypothesis is that the interaction of these em fields with brain generates the perceived sound. On the other hand, in TGD framework these sounds are represented ultimately in the magnetic sensory canvas: thus the intriguing possibility is that the consciously perceived sounds are in fact generated by the direct perturbations of the magnetic or Z^0 magnetic auditory canvas and are genuine ESP effects.

The recorded electrophonic sounds could be induced by electromagnetic perturbations propagating along magnetic mirrors at multiples of the fundamental frequency $f = c/L$ determined by the length L of the magnetic mirror and the mirrors might not only channel the electromagnetic energy very effectively but even act as resonators amplifying the em fields. In fact, in one of the models analyzed in [F2], the electric fields on the surface of Earth must have the same strength as the electric fields created by the meteor in its immediate vicinity in order to explain the data! If the electric fields are channelled along the magnetic mirrors associated with the magnetic sensory canvases to the surface of Earth, the frequency spectrum is automatically in the "thalamocortical" range instead of the expected $20 - 20.000$ Hz range for the sferics and one can understand why only few meteors generate electrophonic sounds. Notice that magnetic mirrors of length shorter than Earth's circumference would give rise to higher resonance frequencies than Schumann frequencies: the required length of the mirror would be roughly 1.26 Earth radii for 40 Hz frequency.

One can imagine tests for the sensory canvas hypothesis and for the possible ESP character of the heard sound (in the sense that the heard sound is induced cortically rather than received from environment).

1. One could construct acoustic amplifier in 37-44 Hz range so that human perceiver could hear both the direct ESP sound and the sound generated by the amplifier. This would mean hearing two "pops", such that the interval between them is determined by the time used to the sensory processing and propagation of the sound from the external source. In fact, in the introduction of [F2] it is mentioned that "many witnesses heard sounds even before they heard the noise inside the house". Assuming that the sounds are both heard and electronically detected, a neurophysiological model for the time lapse from the sensory input to the conscious percept would allow to test whether the consciously perceived sounds can have non-ESP origin. If the lag is too small, ESP interpretation is supported.

2. The human perceiver could use ear plugs. If "pop" is heard also in this case, the only possible interpretation (excluding fraud) is that the sounds are generated either by the neuronal activity stimulated by the interaction of the ELF em perturbation with brain, that the sound is generated in body as physiophonic sound [I6], or that a genuine ESP is in question. The phenomenon of physiophonic sound discovered by Antionio Meucci in 1842 means the amplification of external sounds or electromagnetic signals by musculature and their feed directly to the neural circuits (ears could be closed) and is a rather convincing explanation

for the heard sounds. The possibility of fraud could be eliminated by excluding the possibility of the direct visual perception of the meteor and finding whether the heard sounds coincide with the electronically detected sounds.

6.3.3 UFOs, ETs and magnetic perturbations

Persinger has proposed a model explaining the encounters of extraterrestrials as hallucinations caused by the perturbations of Earth's magnetic field induced by the liberation of the tectonic energy at the lines of tectonic activity [J17]. The model is based on well-established statistics about the effects of the perturbations of Earth's magnetic field on consciousness collected in mental hospitals. The lines of the tectonic activity are also accompanied by well established luminous phenomena which suggests that the model could be naturally combined with the explanation of UFOs as this kind of luminous phenomena.

The most obvious guess is that a beam of visible light or ions emerges from the region where the tectonic energy is liberated. If this beam somehow produces a localized ball lightning type phenomenon it could be interpreted as UFO. If the direction of the beam varies randomly the resulting UFO performs random butterfly like motion and in principle the velocity of motion can be super-luminal since a signal velocity is not in question. The motion would resemble that of a flicker's light spot in a roof. Many UFO candidates have indeed found to move in this manner and this is quite a challenge in the attempts to understand the technology used.

1. Why a light spot rather than beam of light is observed?

The challenge is to explain why a localized pseudo UFO rather than a beam of light is observed.

1. One could consider the possibility that a radial spray of electric flux emanates from the site of the tectonic activity and electrons accelerate in this field until they gain the energy needed to ionize the molecules of the atmosphere and produce visible light. The analog of vacuum discharge would be in question. The problem is that the drifting velocity is achieved very rapidly so that the model works only if the density of molecules of the atmosphere decreases sufficiently fast as function of height. This is not the case.

2. Suppose that the spot of tectonic activity emits dark microwave photons including frequencies $f > 5$ GHz. In this case visible light could result via the de-coherence of the dark microwave photons to ordinary photons. The fraction of ordinary visible photons in the beam would behave as $1 - exp(-h/h_0)$ and at some critical height the beam would become visible as the visible photons scatter from the molecules of atmosphere.

3. Pseudo UFO could be a kind of a mini aurora produced by exactly the same mechanism as auroras. Similar mechanism could apply also to ball lightnings and other exotic luminous phenomena. The super-conducting magnetic flux tubes associated with the stream of magnetic flux assumed to emanate from the site of tectonic energy liberation would intersect with the magnetic flux tubes of Earth's magnetic field (or those emerging from the brain or body of the perceiver of ETs). This would lead to a reconnection process in which magnetic flux tubes having a local U-shape are generated. The inertia of the super-conducting ions (perhaps protons and electrons) would induce the leakage of the ions to the non-super-conducting atmospheric space-time sheet. This in turn would lead to a further ionization and the molecular electronic transitions would generate the visible light as in the case of auroras. Also electric fields could be involved as in the case of auroras. U-shaped structures would occur at definite height. By measuring the local electromagnetic fields one could perhaps test whether the orbit of the pseudo UFO correlates with the variation of the hypothesized stream of magnetic flux emerging from the site of the tectonic activity. The pseudo-UFO character could be tested by finding what kind of radar echoes the luminous region generates (if any).

2. What about ET reports?

The aurora mechanism could explain also the hallucinations as real encounters with other selves of the predicted self hierarchy rather than ETs. The tectonic activity could cause a similar

perturbation of the personal sensory canvas and perhaps its temporal fusion with other sensory canvases, perhaps even with higher multi-brained sensory canvases possibly present. This would obviously induce genuine ESPs. The generalized motor response coming from the sensory canvas would be also involved but primary percept would occur before it. Brain would probably do its best to interpret the situation using concepts provided by the cultural background. Angels, spirits, demons, ETs, etc.. would be various narratives for the same phenomenon.

Also Schumann resonances are excited during tectonic activity and could correlate strongly with the experiences about encounters of ETs: this explanation is consistent also with option b). Similar mechanism might be behind hypnagogic experiences occurring at the boundary between wake and sleep. EEG is dominated by frequencies near the lowest Schumann frequency 7.8 Hz during hypnagogy and this might mean that the entanglement with other sensory canvases occurs with an enhanced probability.

Krishnamurti has told very movingly about experiences of literally being another one. Perhaps also other identification experiences, such as shamanic identification with animals, rely on the same mechanism. Also I have had strange hypnagogic experiences of being a totally different person for a moment. This picture would suggest that magnetic transition frequencies associated with the flux tubes of the magnetic sensory canvas emanating more or less vertically from the head code for the personal content of consciousness whereas Schumann frequencies relate with the transpersonal contribution to consciousness possibly present always and giving rise to a third person bird's eye of view about own person and amplified during hypnagogic experiences or by strong perturbations of Earth's magnetic field.

6.3.4 Anomalous visual percepts and sensory canvas hypothesis

Sensory canvas hypothesis means that at the level of magnetic body we see using ELF– rather than visible light. Of course, if primary sensory qualia are at the level of sensory receptors, this seeing has the character of imagination. Even in this case brain could use back-projection to the sensory receptors assign sensory qualia with the imagination like perception. This would occur during dreaming and what is regarded as hallucinations.

The model of EEG [K7] however leads to the conclusion that the Josephson radiation from cell membrane corresponds to dark photons with EEG frequencies and bio-photon energies so that they can transform to bunches of EEG photons or to bio-photons with ordinary value of Planck constant. This model predicts correctly the frequencies of maximal sensitivity for the four kinds of photoreceptors and a good guess is that this radiation could explain large number of various anomalies in which low frequency radiation has biological effects.

One can also consider the possibility of "vision" as a sensory experience of the magnetic body based solely on the ELF input from brain and body having no correlate with the visible light entering into the retina or even with neural activity. The de-coherence of (for instance) dark ELF photons with frequencies above alpha band level of the dark matter hierarchy to ordinary visible photons could be responsible for this vision.

Even genuinely three-dimensional vision in which own body is seen as it would be seen by the external world suggests itself. The dropping of ions from the atomic space-time sheets to the magnetic flux tubes so that they end up to high n cyclotron states decaying via the emission of photons at frequencies which are harmonics of the cyclotron frequency would generate the projector MEs needed for the sensory representation of the physical body or part of it as seen by the environment. In many-sheeted space-time particles topologically condense at all space-time sheets having projection to given region of space-time so that this option makes sense only near the boundaries of space-time sheet of a given system. Also p-adic phase transition increasing the size of the space-time sheet could take place and the liberated energy would correspond to the reduction of zero point kinetic energy. Particles could be transferred from a portion of magnetic flux tube portion to another one with different value of magnetic field and possibly also of Planck constant h_{eff} so that cyclotron energy would be liberated.

There is some evidence for this kind of anomalous vision.

1. Yogis have reported altered states of consciousness in which they see their own body three-dimensionally, that is simultaneously from all directions. This might have interpretation as ELF vision involving a feedback from magnetic sensory canvas to brain to "qualiafy" the

percept. An alternative interpretation is that the visual experience is visual experience of some other self which is shared by quantum entanglement.

2. Becker tells in his book "Cross currents" [J24] about a young cancer patient who told that he can see the interior of his own body. The patient could also locate the remnant of the tumor correctly. If sensory receptors are necessary for visual qualia, the needed data must be received from somewhere by brain, and be projected to the retinas like during dreaming. The simplest option is that body parts can in some sense "see" each other. In particular, brain can "see" body parts (note that bacteria possess a primitive IR vision based on microtubules). Bio-holography provides support for the body as a hologram. For instance, an electric stimulation of ear during Kirlian imaging of a finger tip creates a Kirlian photo from which it is possible to abstract a hologram of ear (see [I9] and [K9]). One can also imagine that magnetic body "sees" and the mechanism is the transformation of dark EEG photons to visible photons.

3. Also the OBE experiences, for instance those associated with NDEs, could have an analogous interpretation. The sensory input from eyes would be absent but brain would give feedback to visual receptors to "qualiafy" the input which it might receive from other levels of self hierarchy. If even the input from neural activity is absent during NDEs so that the visual experience should be determined by the background ELF component emanating from the brain and body. The third person perspective associated with OBEs might be always present but be masked by the strong sensory input or by the absence of feedback to visual receptors. It is possible to have experiences about contact with deceased by a therapy based on rhythmic eye movements [J2, J11]. The function of eye movements might be to establish a feedback to certain brain regions serving as receivers of input from magnetic bodies of deceased or from magnetosphere. I have developed a detailed model for various kind OBE experiences in [K22].

4. I have proposed thousand and one explanations for the beautiful flow visible when I close my eyes in a calm state of mind. During my "great experience" this background flow was accompanied by extremely vivid visual hallucinations. An additional item to the long list of explanations is following. The information characterizing the flow enters from or via brain to the visual receptors and is in this manner "qualiafied".

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

6.4 Taos Hum

Taos hum is an experimentally well-established anomalous phenomenon which has escaped rational explanations (in the article [I6] a thorough review about nocturnal taos hum is given and the following representation relies on this article). Very concisely, taos hum seems is apparently a subjective experience without identifiable objective counterpart and could thus provide an application for the sensory canvas hypothesis.

The TGD based model for EEG [K7] is based on dark Josephson radiation generated by cell membrane Josephson junctions in the energy range of visible and UV light and covering a wide frequency range. The model explains bio-photons and EEG photons as manifestations of one and same thing. Taos hum could be understood in terms of this kind of Josephson radiation at microwave frequencies generated by living matter during night-time and possibly providing some organisms with an active vision. The emission of negative energy dark photons could also make it possible for plants to suck metabolic energy from environment in the absence of solar radiation.

6.4.1 Basic facts

Taos hum is perceived in and around Taos, New Mexico but similar phenomena are experienced also in Northern America and Northern Europe. The hum is mostly heard during night time. Most people experience the hum as irritating and it causes nocturnal disturbances. From the tests based on psychophysical matching the frequency range of the hum has been deduced to be 40-80 Hz and whereas amplitude is around 60 dB. The hum is a regional phenomenon. The hum does not usually appear between sunrise and sunset. The pitch and intensity of the hum varies inside house and finds the largest magnifications on lower floors. Rooms modify the hum by adding distinctive harmonics to it. The pitch of the hum changes when one moves from outer wall to the interior rooms. Hallways and small alcoves raise the pitch considerably. The wavelengths involved vary between 3.9-7.8 meters for 40-80 Hz frequency range which suggests that resonance effects could be involved. It has been however impossible to identify any acoustic origin for the phenomenon. The presence of effectively acoustic effects suggests that gigantic amplification by the physical (and em!) body of the patient is involved.

Hum can involve also an experience about whirling or roaring wind, kind of vortex although nothing moves around, and coming from all directions. Also a strange amplification of distant sounds can be experienced. White light in the horizon in the direction where hum comes from can be also perceived. Experiences analogous to hum have been reported also in past, even in antique ("Aeolian wind"), but nowadays the number of victims of the hum has increased, which suggests a connection with the emergence of electronics and computers. The direction which hum is experienced to come from seems to be random.

The hum can be accompanied by irritating tactile sensations and neuralgic pain. The unfortunate individual who suffers of extreme HUM disturbances, seems to be controlled by very fundamental and autonomic response-reflexes when in its grips. Such sufferers may behave in semiconscious modes, modelling behavioral patterns seen only in animals. Typically the victim tends to get underground believing that this allows to get him rid of the hum. The victims of hum indeed tend to wake up with the realization that they have very strong and painful muscle tenure.

An important hint as regards to mechanism of hum is the fact that the temporal patterns of the shortwave radio static detectable by shortwave receivers correlate strongly with those associated with the hum. It is also known that the static has a biological origin: the warbling sounds characterizing the static resemble those produced by plants and galvanic skin response sensors. And most importantly, the statics is present during night time.

All attempts to detect the hum instrumentally and to identify its source have failed. This has inspired various kinds of conspiracy theories about the nature of the phenomenon, for instance, the proposal the strong ELF power feed by submarine radars alone could explain the phenomenon.

6.4.2 Phenomena possibly related to taos hum

It is appropriate to discuss first some phenomena possibly related to the taos hum before considering the model for the phenomenon itself.

1. Microwave hearing

During the collaboration with Joaquim Fernandez related to the construction of a a model for so called Fatima miracle [H1] I learned about the phenomenon of microwave hearing [I5] in which microwaves generate an audible sensation. There is evidence that microwave hearing does not involve ears as receivers of the primary signal [I2] and that the sensation of hearing could result as back-projection from cortex to ears.

This, and the correlation with microwave static suggest that taos hum could be a particular case of microwave hearing. The model of sensory representations implies that brain acts as a sending microwave antenna: a natural implication is that brain can act also as a receiving microwave antenna. The size of the brain hemisphere corresponds to a microwave frequency of order 3 GHz and smaller structures inside brain correspond to higher radio frequencies. If primary sensory organs are the seats of the sensory qualia and that back-projections cannot induce physical pain, the presence of the painful tactile sensations means that microwaves must interact also with the sensory receptors at the skin.

Why taos hum? Could animals use microwaves for "seeing" in absence of sunlight? But for what

purpose plants would use microwaves? Could organisms send negative energy $h_{eff} = n \times h$ [K31] microwaves to environment and suck metabolic energy quanta with energy around .5 eV in this manner? Remote metabolism! Or maybe time reversed photosynthesis in dark! Biophotons indeed have energy spectrum in visible and UV as also sunlight does. This would require non-standard value of Planck constant.

This hypothesis would explain why the microwaves causing taos hum not hum are not observed directly. And if something is sucking metabolic energy from you, it is would be rather natural to experience very unpleasant feelings and try to find a place to hide as many sufferers of taos hum try to do!

2. Physiophonic effect

Physiophonic effect is a phenomenon accidentally discovered by Antonio Meucci in 1842, in which vocal signals are electrically transmitted directly into the neurology of listeners [I6]. Physiophonic sound can be often amplified to an enormous volume. A possible interpretation is as externally stimulated internal sound but one can of course wonder whether the transduction to sound is necessary.

Since the body (especially collagen network) is liquid crystal allowing piezoelectric effect in which mechanical vibrations are transformed to electric signal, external sounds could be transformed to electric fields. On course, LC property implies that also genuine sound is generated so that both ELF em fields and ELF sounds can act as amplified signals. One can ask whether strong back-projection to the ears is generated so that sound percept results. This would imply oto-acoustic sounds directly detectable by microphones not found in the case of taos hum.

3. Microwave static and taos hum

It is known that the temporal patterns of the shortwave static detectable by shortwave receivers correlate strongly with those associated with the hum. It is also known that the static has a biological origin: the warbling sounds characterizing the static resemble those produced by plants and galvanic skin response sensors. And most importantly, the fact that the static is present during night time would explain why hum is experienced at night time.

6.4.3 Possible ingredients for the model for taos hum

The facts about the role of the musculature, shortwave radio noise, and the role of acoustic environment combined with the model of microwave hearing based on the notion of dark photons [K10] pose strong constraints on the model of taos hum.

1. Taos hum as sensitivity to alien control commands

Magnetic bodies control biological body by sending control commands to brain and body where they are transformed to nerve pulse patterns and various physiological waves. Also the lower levels of self hierarchy should control the respective levels of the hierarchy, in particular muscle cells, in a similar manner. In the case of hum patient the normal control signal could be replaced by a control signal from some external biological source, say plants, and would be responsible for the muscular vibrations amplified to the hum. In the worst situation the behavior of hum patients reduces to simple reflex actions: these reflex actions would be initiated by fake control signals.

The fact that the taos hum begins after the sunset would conform with the interpretation as sucking of metabolic energy with energy quanta in visible and UV range. The loss of metabolic energy could explain why the experiences of patients are so unpleasant. Since motor action is based on negative energy signals affecting directly neuronal membranes by the same mechanisms as ordinary motor actions the signals would also induce reflex actions.

The situation would be due to the failure of the em (or rather, electro-weak) immune system of the patient. In order to understand what is involved a brief discussion of model of motor control based on charge entanglement induced by W MEs is necessary: a detailed model is discussed in [K9, K10].

1. The exotic ionization of dark matter induced by W MEs generates dark plasma oscillations inducing electric fields which by many-sheeted variant of the Faraday law induce electric fields also at the space-time sheets where ordinary matter resides. Various ionic waves, in

particular Ca^{2+} waves and nerve pulse are examples of the physiological responses resulting in this manner.

2. Dark plasma frequency corresponds to a microwave photon with energy above the thermal threshold and the system must be able to provide dark photons with this energy to generate plasma oscillation patterns serving as control commands.

The electro-weak immune system could fail in the following manner.

1. In the healthy situation em immune system takes care the body is tuned to the personal dark plasma frequencies and does not respond to control commands from alien magnetic bodies associated with say plants.

2. In an un-healthy situation persons plasma oscillation frequencies are tuned to some frequencies in the microwave static and microwave static provides the energy needed to generate plasma wave patterns and thus to realize control commands from the alien magnetic bodies. The plasmoids would induce microwave hearing and generalized motor actions at cellular level exhausting the personal metabolic sources and leading to the painful experiences and fatigue.

2. Taos hum and microwave hearing

The identification of the audible sensation associated with taos hum is in terms of microwave hearing explains the failure of the attempts to identify the source for taos hum. Amplitude modulation by ELF frequencies naturally associated with motor control would give rise to sensation of sound.

Concerning the model for microwave hearing, a good guideline is that the effect is expected to be possible as quantum effect only if the energies of the microwave photons are above the thermal threshold. This would require dark microwave photons for which 5 GHz photons have energy above thermal threshold (6 cm wavelength). Same applies to other effects caused by dark microwave photons.

Microwave hearing itself would rely on hearing of dark microwave photons at visible and UV frequencies. These dark microwave photons could accompany the microwave signal automatically or could be generated by cells via a phase transition increasing the value of Planck constant.

3. Taos hum and microwave seeing

The de-coherence of microwave photons to ordinary photons would produce the biological effects. This could explain also the reported perception of white light as resulting from the de-coherence of the microwave photons at the upper end of the spectrum: 1 mm microwave wavelength would correspond to 2.5 eV photon energy.

The de-coherence of dark microwave static to ordinary visible photons could make possible microwave vision during night time. This could explain why the static emerges after the sunset. Plants could also generate negative energy dark microwave photons with energies in the frequency bands of visible photons involved with photosynthesis to satisfy their metabolic needs when they do not receive sunlight. One can of course wonder whether the quartz in the rock heated during day-time could generate dark microwave photons during night-time serving as a metabolic source.

3. Taos hum as a failure of the electromagnetic immune system

Taos hum starts immediately after the sunrise and stops after the sunset and seems to have a biological origin. The magnetic bodies of (say) plant cells could send dark energy photons at microwave frequencies above 5 GHz: one reason is that they become visible in this manner.

Negative energy W MEs in the same frequency range and responsible for quantum bio-control in the time scale of microwaves could be involved. Due to the failure of the electro-weak immune system the surrounding biosphere could induce generalized motor actions and these would exhaust the metabolic energy resources of the victim. This would explain why the hum is intolerable and the extreme fatigue caused by it.

The radio noise generated by computers and other sources of radio waves should not cause troubles if these radio waves correspond to ordinary photons. If not, then the microwaves in question could provide the energy needed to realize alien control commands based on ELF modulation.

4. An explanation for 40-80 Hz modulation

The model of biological evolution and evolution of nervous system based on dark matter hierarchy [K7] leads to sa detailed identification of the values of Planck constant associated with EEG identified as of dark Josephson radiation with energies in visible and UV range and EEG frequencies. This level is involved with all life forms capable of genetic expression, in particular plants. Therefore the ELF modulation of microwave frequencies could be due to the control commands from the levels of the magnetic body normally meant to control the genetic expression of say plants. The modulation of the microwaves with EEG frequencies, in particular with the frequencies in the $37-44$ Hz thalamo-cortical resonance band, could force the patient to stay awake by not allowing the dominant EEG frequencies to drop down to theta and delta region of EEG as occurs during sleep.

5. Is stochastic resonance involved?

One could also ask whether the microwave static of victims of taos hum is anomalously amplified by some mechanism so that control commands from alien magnetic bodies can be realized. The transduction of weak microwave signals to mechanical oscillations by piezo-electric body liquid crystals, and the amplification of this signal in the presence of a metabolic energy feed to the musculature, could lead to this kind of situation.

Stochastic resonance with white noise generated by body provides one possible amplification mechanism. Micro-wave frequency would correspond to the amplified frequency. If so, one could perhaps understand why only some persons experience the hum and why the effect is strong at night time. White noise would be generated by body. White noise induces jumps between the states of the 2-state system with an average frequency f_K (Kramers frequency) which depends on the autocorrelation function of the white noise and the properties of the 2-state system [K20]. If the Kramers frequency satisfies $f_R = 2f$, where f is the frequency of the signal, a resonant amplification occurs. The dependence $f_K \propto exp(-\Delta V/D)$, where $\Delta V > 0$ is the height of the potential barrier separating the states of the 2-state system, implies and exponential sensitivity of f_K on $1/D$, where D is the intensity of the white noise. Hence the failure of the em immune system could be due to the too intense white noise produced by the body of the victim or due a too low height of the potential barrier.

6. Are electronic systems involved with the hum?

The fact that the number of victims of hum has rapidly increased during the era of radio communications and computers and suggests that both radio noise and computers might be actively involved with the hum. Also ELF noise from electronic systems might be important if these systems generate dark ELF photons.

Electronic instruments generate also frequencies in the range $40-80$ Hz, in particular the 50 Hz frequency associated with the household electricity. Also submarine radars generate very strong ELF signals. The liquid crystal character of human body implies that besides weak sound signals also these ELF signals can contribute to the signal amplified by musculature. If these signals correspond to the lowest level of dark matter hierarchy, they should not have biological effects but whether this is the case is not all clear.

The strong coupling between magnetic flux tube structures associated the with computer networks and sensory canvases might be created by the magnetic reconnection process during night time when the shape of the flux tube structures changes. Also whole-daily use of a computer could generate magnetic mirror bridges between the computer and user's musculature and allow computer to feed fake control signals to muscles.

6.4.4 Is hum possible in other sensory modalities?

The model of hum based on magnetic sensory canvas suggests that the effect is involved with all sensory modalities. Tactile sensations, in particular pain, are certainly involved. It was already mentioned that hum experiences can involve also perceptions of white light in the horizon in the direction from which hum came. In the model explaining the sensation of hum as being caused by the muscular sound, this sensation could result as a kind of cross-modal association accompanying very intense auditory sensation. In the model explaining the effect as ESP the presence light sensation could be understood as visual aspect of the ESP.

My personal experiences provide a candidate for the counterpart of taos hum in visual field. While closing eyes in a calm state of mind, I see a strange and complex flow consisting of small dots: for the first time I had this experience during my great experience roughly 15 years ago. The effect is easiest to achieve with lightly closed eyes but appears after some time also with tightly closed eyes. For lightly closed eyes the flow is more complex whereas for tightly closed eyes there is just a sink in the middle representing what I would call "third eye", which is present practically always. Vortices and spiral vortices (compare with the whirling winds associated with hums) are typically involved and flow can have also weak coloring.

Could this flow be the visual counterpart of the taos hum? The very fact that the experience is pleasant and the appearance of diffuse white light during taos hum suggests that this interpretation need not be quite correct.

1. The effect is caused by the de-coherence of dark microwave photons or perhaps dark EEG photons above alpha band to visible photons (during calm states of mind alpha band is very strong).

2. This effect is strongest when the eyes are only lightly closed. Perhaps ELF em waves from some source could provide the input to the retina which is magnetic structure and generate the visual sensation somehow (note that rotating non-colored Benham top can generate sensations of color). The de-coherence of dark ELF photons to ordinary visible photons could be the mechanism.

3. I have proposed an interpretation for the flow in terms of the magnetic flux tube structure emerging from the retina. One can however wonder why just single central vortex rather than two? Could it be that pineal gland, which is also a magnetic structure and contains retinal pigments and is "third eye" in rather literal sense, could be responsible for the "third eye" component of the flow, and that during eyes lightly closed conditions turbulent retinal and single vortex like pineal contributions superpose? Could pineal vision be based on the de-coherence of EEG waves above alpha band to ordinary visible photons?

What is perhaps remarkable that the ability to have the flow experience has stabilized during last year or two, which is also the period during which various hum symptoms have developed. However, I experience the flow also when the computer is off: as a matter fact, I experienced the flow for 15 years ago when I did not work with computers.

6.4.5 Personal experiences about hum

While learning about taos hum, I suddenly realized that I am perhaps not an objective outsider at all! I cannot tolerate the humming noise of the refrigerator: in order to sleep at all I try to insulate myself from the kitchen by cloth (I do not have door between) and use pillows on my ears in order to get rid of this extremely irritating sound. Even this is not enough and I wake-up very often during night-time. I also used to have terrifying experiences in which the noise of the refrigerator started to increase in volume and my body started to float and was attracted by the refrigerator as if it were a conscious creature wanting to fuse with, or rather steal, my consciousness (by the way this suggests that magnetic selves strongly interacting with my magnetic body might be really involved). I can also hear sounds, such as cracks from wall, as amplified to completely abnormal intensity (in fact I have always had abnormally sensitive ears).

I suffer also from almost intolerable hum of my computer at day-time and only while learning about taos hum, I realized that similar mechanism might be at work also here (note however that taos hum is strongest during night time, between 9 P.M. and 9 A.M.). Remarkably, the hum amplifies when I become conscious of it: I can work long times without noticing its presence at all. Neither am I aware of the refrigerator at daytime. To complete the picture, two years ago I began to suffer from chronic pain in head, neck and back which are due to strong muscle tensions. These pains correlate very strongly with working at the computer terminal. I have believed that this is due to the bad working ergonomy and poor quality of eye glasses. However it turned out that this was not the reason of pains. I have even suffered from temporal dizziness when pains have been worst and even lost my consciousness once: strangely enough, I heard before the loss of consciousness a strange whirling wind to blow (sic!), and realized only later that weather had been completely calm.

It seems that all these symptoms fit with those of a hum patient. Now only the source of radio waves would be my own computer and would act also at daytime via direct radio wave magnetic mirror bridges connecting the oscillating circuits of the computer to my musculature. When I am not aware of the noise, my brain does not project sensory input from muscles to the auditory canvas and I am saved from the hum sensation. I however feel the pain coming from the body all the time.

On basis of what has been said, it would seem that there is high time to consider the possibility that the electric pollution of environment is gradually making our life increasingly intolerable. One cannot even exclude demon like conscious virus like entities generated by the electronics and computers and fighting for survival with us.

7 Evidence for quantum brain

The recent findings suggest quantum coherence in the brain scale. The quantum coherence would make itself visible in the magnetic resonance imaging (MRI). The findings are described in the popular article in Scitechdaily (`https://cutt.ly/0NtnxwZ`). The research article "Experimental indications of non-classical brain functions" by Christian Matthias Kerskens and David Lopez Perez [J4] is published in Journal of Physics Communications (`https://cutt.ly/0NtnEKz`).

The system studied is the brain and cyclotron resonance of protons in "brain water" is involved. The goal was to find whether there exists evidence for macroscopic quantum entanglement. The work was based on the proposal that some quantum coherent, non-classical, third party, say quantum gravitation, could mediate quantum entanglement between protons of brain water. NMR methods based on so-called multiple quantum coherence (MQC) act as an entanglement witness.

The work of Kersens and Perez was inspired by a theoretical work of Bose et al in which a possible method allowing to witness quantum gravity by spin entanglement [**?**](`https://cutt.ly/CNhF2Ev` was discussed.

In the sequel, the proposal of Bose et al for generating entanglement by quantum gravitational interaction between mesoscopic objects is first discussed. A superposition of two locations for the objects is required. It is assumed that it is possible to correlate the locations with spin values. Entanglement would be generated by different phases, which evolve to different pairs of components of objects and measurement of spin would demonstrate the presence of entanglement.

Mechanisms generating quantum coherence in scales of at least 10^{-4} meters and giving rise to a superposition of locations are needed but are difficult to imagine in the standard view of quantum gravitation.

In TGD, the mechanism would be different. Gravitational Planck constant $\hbar_{gr} = Gm/v_0$ associated with Earth-test particle interaction could generate quantum coherence in even brain scale and gravitational Compton length $\Lambda_{gr} = GM/v_0 \simeq .45$ meters, where $v_0 \simeq c$ a velocity parameter characterizes the lower bound for the quantum gravitational coherence scale. The analogs of magnetized states assignable to microscopic objects of size scale 10^{-4} meters take the role of spins and spin-spin interaction generates the entanglement, which is detected by measuring the spin of either object just as in the case of ordinary spins.

7.1 Could spin entanglement be used as a witness for quantum gravitation

The basic idea of the two [J4] and [**?**] is that quantum gravitation can be witnessed by the entanglement induced by it.

7.2 Could quantum gravitation generate spin entanglement for quantum superpositions of locations?

In the article "A Spin Entanglement Witness for Quantum Gravity" of Bose et al [**?**](`https://cutt.ly/CNhF2Ev` a detailed proposal how the quantum gravity could generate entanglement in scale $d \sim 10^{-4}$ meters.

1. The masses $m_1 = m_2 = m$ considered are of order 10^{-14} kg and would correspond to a water blob of size about 10^{-5} m with mass of order $m \sim 10^{-3} m_{Pl}$. The masses m_i would be at

a distance $d \sim 100\ \mu m$, which corresponds to the size of a large neuron having mass about Planck mass. One has $\alpha_{gr} = Gm^2/\hbar \sim 10^{-6}$. So that the interaction energy at distance d would be $Gm^2/d \simeq 10^{-8}$ eV, which is much below the thermal energy.

2. The idea is that although the gravitational interaction energy is quite too small, quantum gravitational interaction between masses m_i could be detectable via a generation of quantum entanglement. The additional assumption, bringing in mind the Orch-OR hypothesis, is that superpositions of 2 locations are possible for the masses and the separation scale Δx is of order $d/10$. The mechanism causing this superposition is not discussed. What comes into mind is gravitational double well potential.

3. One considers a situation in which each mass is a superposition L+R of locations for the center of mass. One assumes that it is possible to assign to the locations L and R opposite spins so that the measurement of spin would perform a state function reduction inducing a localization to either R or L configuration.

   The distance of the masses has the scale d. One assumes that the masses behave like quantum coherent objects describable by a scalar field, and assumes that they fall freely in the gravitational field of Earth for a time of order of a few seconds.

4. The mathematical model assumes standard perturbative quantization of the gravitation using quantum field theory in Minkowski space. The situation is assumed to be static so that only the component g_{tt} of the metric and radiation part of the gravitational field matters in the description of the interaction.

5. The initial state is an unentangled product of states but their mutual quantum gravitational interactions LR and RL corresponding to distances $d + \delta x$ and $d - \delta x$ of masses generate different phase factors. After this, these analogs of photon beams superpose again and interference takes place. The predicted difference of the phase angle is of order 10^{-4} and might be measurable with recent technology.

7.3 NMR as a witness for quantum gravitational entanglement

The experiment carried out by Kerskens and Perez [J4] was not based on interferometry but on nuclear magnetic resonance imaging (MRI).

It is far from clear that the ordinary NMR signals can contain quantum correlations of the spectrum in the hot and wet brain environment. Therefore a witness protocol, which eliminated the "classical" background from known sources was used.

To achieve this, the "classical" sources of entanglement had to be eliminated. This was achieved by irradiation of the brain region with a radiation inducing cyclotron transitions to higher energy state so that the situation would become saturated and one would have a statistical dynamic equilibrium. In a statistical sense, the temporal patterns associated with the transitions from a higher state to a lower state causing cyclotron radiation patterns visible in MRI would be absent. In this back-ground the presence of "non-classical" sources of cyclotron emission would be visible. This source could correspond to a formation of pure entangled state which would decay by emitting cyclotron radiation.

What was found, was a periodic pattern in MRI with a frequency of heart beat, interpreted in terms of evoked membrane potentials. This pattern is too weak to be visible in the ordinary MRI. What looks surprising is that the frequency was that of heart beat; one would expect some resonance frequency of EEG, say 10 Hz. Premumably, the the possible evoked potentials due to the heartbeat were intentionally chosen as as a target of attention.

The finding fits very nicely with the TGD view of brain and quantum biology, in particular the TGD view of genetic code [**?**, **?**, **?**, **?**].

1. In the simplest model, sequences of dark protons (ordinary protons with effective Planck constant $h_{eff} = nh_0$, which can be very large) at the flux tubes of the magnetic body associated with DNA would realize genetic code as sequences of dark proton triplets. Besides dark nucleotides, also dark codons and dark genes as quantum coherent dark 3N-protons would be possible and characterized by very large value of h_{eff}.

Also dark photon triplets would realize codons and give rise to dark genes as sequences of dark codons: 3N-photons. Communications between dark genes and would occur using dark 3N-photons by dark 3N-resonance. The 3N-frequency would serve as an address somewhat like in LISP and the modulation of frequency scale would create a sequence of resonances analogous to sequence of nerve pulses.

EEG would closely relate to the dark photon radiation between the magnetic body and brain. Also generalizations of EEG to other frequency ranges are suggestive.

2. The dark magnetic flux tubes would be associated with water and its numerous thermodynamic anomalies and exceptional role in biology, could be understood by the presence of a dark phase involving long gravitational flux tubes carrying dark protons with $h_{eff} = h_{gr}$.

   The required values of h_{eff} are huge, and this led to a connection with the Nottale hypothesis of gravitational Planck constant $\hbar gr = GMm/v_0$, $v_0 \leq c$ is a velocity parameter. One would have $\hbar_{eff} = \hbar_{gr}$. The value of velocity parameter can be estimated from various applications. It would have a spectrum with the largesty value $v_0/ \simeq 1$ in the case of Earth with $M = M_E$.

3. TGD leads also to an identification of B_{end}. TGD predicts monopole flux tubes (CP_2 homology is non-trivial) distinguishing TGD from Maxwellian electrodynamics. $B_{end} = 2B_E/5$ is identified as the monopole flux part of the Earth's magnetic field. The monopole flux tubes would carry dark matter and since they have huge quantum coherence scales, would naturally control ordinary biomatter. The control would involve frequency modulation by the variation of the thickness of the monopole flux tubes which would affect the field strength by the conservation of the monopole flux. The variation of the frequency scale would induce at the end of the receiver sequences of cyclotron resonance analogous to nerve pulse patterns.

4. Magnetic body of DNA carrying dark DNA is expected to act as controller of the ordinary biomatter using cyclotron resonance mechanism. In particular, important biorhythms could correspond to cyclotron frequencies. Heartbeat defines one such biorhythm.

   DNA nucleotide cyclotron frequencies are about 1 Hz for B_{end} assigned to the monopole flux tubes. Also for DNA sequences, such as codons and genes, the average cyclotron frequency would be around 1 Hz because the nucleotides carry the same charge and charge to mass ratio Ze/m, so that the cyclotron frequency depends only very weakly on the length of quantum coherent dark DNA segment.

5. The variation of the heart beat frequency could be understood in terms of the variation of the monopole flux tube thickness for dark DNA. This variation would be basic motor action of MB making possible control of biomatter using frequency modulation inducing sequences of resonances manifesting as pulses. Nerve pulse patterns could be one manifestation of this mechanism.

7.4 How quantum gravitation could generate spin entanglement in TGD Universe?

One source of theoretical inspiration for the work of Kerskens and Perez [J4] was the article "Spin Entanglement Witness for Quantum Gravity" of Bose et al [**?**].

Classical interactions, be their gauge or gravitational interactions, cannot generate entanglement whereas their quantum counterparts do so in scales smaller than the scale of quantum coherence.

1. The first open question is whether quantum gravitation is able to generate quantum coherence in long length scales such as the scale of the brain. The fact that gravitation has infinite range and is unscreened might allow this. This however requires a new view of quantum gravitation.

   A gravitational 2-particle interaction or interaction induced by quantum gravitation is needed to entangle the systems. If spins or possibly magnetizations are in question, the entanglement can be detected by spin measurements as done in the experiment. The interaction must be such that it can be distinguished from ordinary magnetic interactions.

2. If objects with mass above Planck mass behave like quantum coherent particles with respect to quantum gravitation rather than consisting of small quantum coherent units such as elementary particles, the gravitational fine structure constant $\alpha_{gr} = GM_1M_2/\hbar$ between objects satisfying $M_1M_2 > m_{Pl}^2$ becomes strong and one expects that the situation becomes non-perturbative.

   The condition $M_1 = M_2 = m_{Pl}$ is satisfied for a water blob of radius $\sim 10^{-4}$ meters and corresponds to the size of a large neuron [**?**, **?**]. The gravitational interaction energy GM_1M_2/d for distance $d \sim 10^{-4}$ m is about 10^{-2} eV and of the same order of magnitude as thermal energy.

3. In the interferometer experiment a much larger phase difference could be generated in the TGD framework but the problem is that it is difficult to imagine a mechanism for creating a superposition of 2 locations of mesoscopic or even microscopic objects.

4. It is also difficult to imagine a mechanism creating 1-1 correlation between location and spin direction (analogous to entanglement associated with spin and angular momentum).

7.4.1 The notion of gravitational Planck constant

The basic problem is what makes the quantum coherence scale so long.

1. In the TGD framework, the non-perturbative character of the situation for $Mm \geq m_{Pl}^2$ motivates a generalization of the Nottale's hypothesis stating that the gravitational Planck constant $\hbar_{gr} = GMm/v_0$, $v_0 < c$ a velocity parameter. $\hbar_{eff} = nh_0 = \hbar_{gr}$ would be associated with gravitational flux tubes to which interacting masses M and m are attached, and would replace $\hbar$ with the gravitational fine structure constant $\alpha_{gr} = GMm/\hbar > 1$ meaning that $Mm > m_{Pl}^2$ is true. One could say that Nature is theoretician friendly and makes perturbation theory possible. This applies also to other interactions.

   The gravitational Compton length $\Lambda_{gr} = GM/v_0$ does not depend on the mass m at all. For the mass of order Planck mass assignable to a large neuron one has $\Lambda_{gr} = L_{Pl}/v_0$, which is of order Planck length. Much longer quantum coherence scale is however required.

2. In the case of the Earth, the basic gravitationally interacting pairs would be Earth mass and particles of various masses. The gravitational Compton length $\Lambda_{gr,E} = GM_E/v_0$ does not depend on the small mass and is about .45 cm for $v_0 \simeq c$ favored by TGD applications. By the way, this scale corresponds to the size of a snowflake [**?**].

   $\Lambda_{gr,E} \simeq .45$ cm defines a minimum value for the gravitational quantum coherence scale but much larger coherence lengths, say of order Earth radius, are possible. The size scale of the brain or even body would define a natural scale of quantum coherence. For objects with a size of order of a large neuron, the gravitational interaction could be quantal in scales of the brain, and actually in the scales of the magnetic bodies assignable to the organism.

3. Earth-particle interactions can induce quantum coherence in the scale of the brain and the masses could be taken to be of the order of Planck mass so that they would correspond to water blob with size of 10^{-4}, so that their distance could be larger than d. This raises the hope that the effects of quantum gravitation quantum coherent in cell length scale or even longer scales could be measured although the interaction itself is extremely weak for elementary particles.

4. For $r = 10^{-4}$ meters, $M = M_E$ would give $E \sim e^2/410^2$ eV ~ 2.5 eV. For $r = 5 \times 10^{-4}$ meters this would give $E \sim .01$ eV, roughly the thermal energy at the physiological temperature.

TGD allows the possibility of detecting gravitational interaction energies for objects of mass of say Planck mass or larger. In fact, the large value of gravitational Planck constant increases the extremely tiny cyclotron energies of ELF photons in EEG range to energies above thermal energy at room temperature [K11, K16, K17] [**?**].

7.4.2 A possible TGD based mechanism generating spin entanglement

These considerations suggest a TGD based mechanism for the generation of spin entanglement, which is not directly based on quantum gravitational interaction but on microscopic and even macroscopic qravitionally induced quantum coherence making possible a generalization of the spin-spin interaction as a way to generate entanglement.

1. Spin should correspond to an analogs of macroscopic magnetization rather than individual spin. Spin-spin interaction between "mesoscopic" defined by quantum coherent particles characterized by $\hbar_{gr}$ and having mass about Planck mass generates the entanglement which can be detected by measuring the "spin" of either particle. As a consequence also the "spin" of the other particles is determined and one has a standard situation demonstrating that the particles were entangled before the measurement.

   Large value of the energy due to the large value of $\hbar_{gr}$ could mean that one has a dark Bose-Einstein condensate like state with a large number of ordinary particles, say protons at the gravitational flux tube representing the quantal magnet behaving like spin.

   In the TGD framework, Galois confinement provides a universal mechanism for the formation of many-particle bound states from virtual particles with possibly momenta with components in an extension of rationals . The total momentum would have integer components using the unit defined by the size scale of causal diamond (CD).

2. The dark cyclotron energy $E_c = \hbar_{gr} eB/m = \Lambda_{gr} eB$, $\Lambda_{gr} = GM/v_0$ of a mesoscopic particle whose particles are associated with (touching) the dark monopole flux tubes of the Earth's gravitational field, does not depend on its mass and is large.

   The magnetic field created by this kind of particle would correspond in the Maxwellian picture to a field $B \propto \hbar_{gr} e/mr^3$. This would give for the magnetic interaction energy of the mesoscopic particles the estimate $E \sim \mu_1\mu_2/r^3 = e^2\Lambda_{gr}^2/r^3$.

8 TGD based model for the solar magnetic field, solar cycle, and gamma ray emission

Sabine Hossenfelder gave a link to a popular article (see `http://tinyurl.com/y6mpuggu`) telling about rather shocking new findings about Sun.

8.1 Solar surprise: looking sunspots again after decades

There are 5 times more gamma rays than expected and the spectrum has a deep and narrow dip in 30-50 GeV range. Spectrum continues to much higher energies than expected, at least up to 100 GeV. One proposal is that there could be dark matter in the interior of Sun yielding the gamma rays but is unclear how they could get to the surface without experiencing the same fate as the ordinary gammas from nuclear reactions. There is also a correlation with sunspot cycle (see `http://tinyurl.com/aqw2hmz`). Basic data and observations related to correlations with the solar cycle are described in the article [E5] (see `http://tinyurl.com/yxajyzp8` and [E4] (see `http://tinyurl.com/y2qlaaa2`).

1. Power law spectrum is harder than for cosmic rays: spectral indices are $n = -2.2$ and $n = -2.7$ respectively (one has power law behavior E^n for the flux). The spectral intensity at 100 GeV is very nearly the maximum flux predicted by the model assuming that reflection of cosmic gamma rays explains the gammas.

2. The spectrum has two components: poloidal component farther from equator and equatorial component largest during sunspot minimum. The equatorial contribution is maximal at solar minimum. The spectral index of the equatorial contribution is harder and higher energies are present. The energy range is maximal during spot minima. Gamma flux is reduced during sun spot maxima.

How the observed gamma rays could be produced in TGD Universe?

1. Gamma rays cannot cannot be produced by nuclear reactions as ordinary gammas since nuclear energy scale is much below the scale of gamma rays extending to 100 GeV at least. Even the hadronic energy scale is too low. The gamma rays could be cosmic rays having already high energies: the spectral indices are however different. This leaves acceleration of charged particles producing gamma rays as the most plausible mechanism irrespective of whether the charged particles come from solar core or are cosmic rays.

2. Dark magnetic flux tubes are basic notion of TGD and could serve as the channels along which charged particles could propagate to the surface without losing their energies in collisions. An interesting hypothesis considered already earlier is that solar magnetic field are what I call wormhole magnetic fields [K24] consisting of closed monopole flux tubes with flux and return flux at different space-time sheets connected by tiny wormhole contacts. This would predict that the flow is not evenly distributed but reflects the structure of the flux tube distribution. If the flux tubes have same M^4 projection they cause no effects on test particle and behave like dark energy creating only long range gravitational fields.

   Charged particles could accelerate in the electric field of flux tube as they travel along flux tubes and generate gamma rays by some mechanism. The energy would be the increment of Coulomb energy if dissipation is neglected. A simple modification of flux tube type extremals allows the presence of helical magnetic and electric fields along flux tube orthogonal to each other. I have proposed the same mechanism to explain the gamma rays and high energy electrons at MeV energies associated with lightnings [K3]: in standard physics framework dissipative losses do not allow them.

3. What could be the production mechanism of gamma rays? If flux tubes have sharp kinks, charged particles should experience large deceleration in the kinks and could emit high energy gamma ray in the process. The highly relativistic charge particle itself could leak out (one cannot exclude nuclei from solar core). Large deflection angles however requires transfer of momentum also to flux tube degrees of freedom.

4. What could be the origin of the tip around 30-50 GeV? If the acceleration takes place in the electric fields assignable to the closed flux tubes assignable to solar dipolar magnetic field, the charged particle could travel several times around the loop giving rise to several energy bands explaining the gap and suggesting several of them. The flux loop would act as a particle accelerator.

5. The charged particles could be provided by the solar core or they could be cosmic rays. The order of magnitude for gamma ray intensity is 5 times larger than in cosmic ray model, which encourages the identification as cosmic rays (see `http://tinyurl.com/psdp99h`). The origin of cosmic rays is however also a mystery and neutron stars, supernovae, active galactic nuclei, quasars, and gamma-ray bursts have been proposed as sources of cosmic rays.

   A possible mechanism producing cosmic rays could be pair-annihilation of pairs of M_{89} pions with mass about 70 GeV [K15] to gamma ray pairs or charged particles with energies 35 GeV. Could the dip observed in the energy range around 30-50 GeV somehow relate to the charged decay products of M_{89} pions accelerating in the electric fields of flux tubes? Could the dip be gap without the decays of M_{89} pions?

   In TGD the model for the formation of galaxies, quasars, and active galactic nuclei, and even stars, and planets relies on the formation of looped tangles along long thickening cosmic strings with topology resembling that of dipole magnetic field. Galactic matter would be produced by the decay of the flux tube energy to particles as analog of the decay of inflaton field. This could generate both charged particles and gamma radiation in the solar core and in neutron stars. The acceleration could be much more effective due to the strong magnetic and electric fields involved. Also charged particles can leak out from the flux tubes and cosmic rays could be produced by this mechanism. Cosmic rays could move along the highways defined by the long magnetic flux tubes connecting galaxies.

The understanding of the correlations with the solar cycle requires a model for the polarization flip. One can consider several options but the model based on reconnection splitting dipole loops

from the flux tube tangle representing the analog dipole field is the simplest one. The simplest variant of the model requires zero energy ontology (ZEO) and quantum coherence at dark flux tubes in solar length scales and that long galactic string defines wormhole magnetic field with two sheets (type I and II) connected by wormhole contacts separated from each other in the sense that M^4 projections are disjoint.

1. Let us denote the numbers of dipole loops of type $i = I, II$ by n_i. Assume that in the initial situation one has $(n_I = n_{max}, n_{II} = 0)$. B as maximum value B_{max}. The arrows of time at the two sheets are assumed to be opposite during cycles.

2. The transition leading $B = B_{max}$ to $B = 0$ would be "big" state function reduction (BSR) changing the arrow of time at sheets of both type I and II. BSR would generate maximum number of new dipole flux loops of type II: $n_{II} \to n_{max}$ so that one has $n_I = n_{II} = n_{max}$ and $B = 0$.

3. After that dipole loops of type I begin to split away by reconnections in "small" state function reductions (SSRs) so that n_I decreases. They split further in pieces and leak out from Sun whereas n_{II} remains unchanged since it corresponds to the passive boundary of CD - this is essential. Net B increases until one has $B = -B_{max}$.

4. Next occurs BSR generating maximum number of new flux loop portions of type I leading $n_I = n_{II} = n_{max}$ and $B = 0$ and same is repeated except that now n_{II} decreases.

5. One can understand the sunspot cycle in terms of split dipole loops leaving the Sun: their intersection with the solar surface would define sunspot pair and the distance of members of the pair would decrease to zero during the cycle.

The model leads to rather dramatic predictions.

1. Various magnetic structures are predicted to appear in pairs with members related by an approximate Z_2 symmetry. For the magnetic field of the Sun this symmetry would be naturally inversion symmetry with respect to the surface of Sun. Also reflection symmetry can correspond to Z_2. This symmetry should be universal and the predictions are in sharp contrast with the locality principle of classical physics. One could even understand the mysterious "Axis of Evil" associated as anomaly of CMB and apparently giving special role for solar system (see `http://tinyurl.com/yb6nabw4`).

2. Also unexpected connections with TGD inspired views about biology and consciousness emerge. Magnetic body (MB) is the intentional agent in living system Z_2 realized as inversion could related the parts of MB in the interior and exterior of Earth: could the idea about intra-terrestrial life introduced originally half-jokingly [K11, K12, K5, K5] make sense - at the level of MBs at least? ZEO based theory of consciousness predicts that conscious entities can have both arrows of time and death means reincarnation with opposite arrow of time. But where do these ghostly selves with opposite arrow of time reside? Could Z_2 - possibly realized as inversion - relate these selves to each other.

8.2 How the magnetic fields of galaxies and stars are generated?

To get a general enough perspective about the generation of time dependent B, one must consider the general model for how the magnetic fields of galaxies, stars, and planets are generated.

1. The magnetic fields of galaxies, stars, and planets would have formed as tangles along cosmic strings thickened to magnetic flux tubes carrying monopole flux. . Tangles would be formed by the flux tubes forming knotty structures with flux tubes defining analog for subset of flux lines of dipole field. The flux tubes can organize in several ways.

   Cosmic strings would be wormhole magnetic fields carrying opposite monopole fluxes at space-time sheets connected by wormhole contacts (in principle it is possible to consider also single-sheeted monopole fluxes). I will talk about sheets of type I and II. If the flux tubes are on top of each other in the sense that M^4 projections are identical, the magnetic field

experienced by test particle touching both flux tubes would vanish. The fact that the energy of the flux tubes gives rise to gravitational field can be used to argue that one can talk about dark energy in this case. The flux tubes can be connected by extremely short wormhole contacts at places, where they are on top of each other. If the Euclidian wormhole contacts can have tube-like M^4 projection, they would be also flux tube like.

2. It is not clear whether the flux tubes of both type I and II are inside the volume bounded by Earth's B or whether second type of flux tubes are outside Earth. This gives rise to several options for how B can be realized as flux tube field and how the time dependence of B is obtained.

3. One can imagine two options, which apply to both types of fluxes separately. For the most general option (Option I) the incoming flux tube can divide to smaller flux tubes going both to the interior and exterior of the dipole core. The extreme options (Option II and II) are that it flows entirely to the dipole core or divides to flux tubes travelling outside the dipole core (this situation is analogous to hydrodynamical flow past obstacle). It will be found that option II is most attractive one.

4. Incoming flux long tube at given sheet forms a tangle. Consider first the tangle formed by the incoming long flux tube of given type at fixed space-time sheet, for definiteness restriction the consideration to flux of type I..

   (a) For Option I the neighbouring flux portions of the flux tube portions inside and outside dipole core can have random orientations: this would be like random spin system without any magnetization. The average observed field would be random. For Options II and III this kind of situation is not possible.

   (b) The flux tube in the tangle can also arrange like spins in spontaneous magnetization so that neighboring portions of the flux tube are parallel both inside the core and outside it. The flux and return flux would be at different sides of the dipole core. This could give rise to an analog of say dipole field. For instance, dipole core could correspond to a spherical volume bounded by the Earth's surface. The extreme situation would correspond to Option II or III.

5. For Option I the polarity of observed B could be due to a process analogous to spontaneous magnetization, whose degree can vary. The degree of magnetization would be determined by the ratio of the incoming fluxes going to the interior and exterior of the dipole core. The total flux Φ flowing inside dipole core is $\Phi = (p_1 - p_2)\Phi_{in}$, where p_i are the fractions of incoming fluxes going inside the dipole core and outside it. If the ratio equals to unity the net B vanishes in long enough scales. For Options II and II one cannot have time varying B unless the number n_i, $i \in \{I, II\}$ of dipole loops can vary.

   Polarization reversal could be a dynamical process. For the analog of hydrodynamical flow the portions of the flow going through the dipole core and its exterior could change, and the fraction of these portions is the parameter determining the strength B. Oscillating B would mean oscillation of this fraction. Also the numbers n_i change and induce change of B.

6. If the flux tubes of both types are in the volume carrying B, more possibilities arise for Option I since the flux tube portions of type I and II can have magnetizations of varying degree and these can be parallel or opposite inside (outside) dipole core.

7. For Options II and III the magnetization direction cannot vary unless n_i can change and the total average magnetic field would vanish for $n_I = n_{II}$. n_i can however change if dipole loops split away by reconnection. It turns out that option II is the most promising one.

8.3 A model of solar magnetic field in terms of monopole flux tubes

The model relies on the notion wormhole magnetic field with flux tubes carrying electric fields, the notion of reconnection, and the theory of quantum measurement based on zero energy ontology (ZEO) [K25] and extending to a theory of consciousness [**?**].

Also hydrodynamic analogy, the analogies with ferromagnetic hysteresis cycle, spontaneous magnetization, and de-magnetization, the analogy with the Meissner effect explaining solar spots as magnetic flux branching from the dipole axis of solar magnetic field, and Lenz principle (induction law) stating that magnetic field generates ohmic current in turn generating magnetic field opposing the change of the magnetic field , are used as guidelines.

1. One can argue that the magnetic fields in question correspond to flux tube portions carrying monopole flux. The empirical support for the hypothesis comes from the fact that monopole fluxes need no currents to generate them. Cosmology is indeed full of long range magnetic fields whose presence is mystery in Maxwellian electrodynamics.

2. Interaction of two kinds of magnetic fields would be involved. The first magnetic field identified as solar magnetic field, call it B, is assumed to have flux tubes wormhole magnetic field carrying monopole fluxes. No current is needed to create the magnetic flux: something impossible for ordinary Maxwellian fields. Note also that the cross section of flux tube is closed 2-D surface. One could call B topological magnetic field. Mathematically B could be seen as an analog of the external magnetic field H generating as a response total magnetic field as a sum of H and magnetization M.

   Second magnetic field, call it B_1 would be Maxwellian and generated by Faraday induction. By Lenz principle it opposes the change of the magnetic flux associated with B and has roughly the same direction. B_1 would correspond to M. In the proposed framework the induced currents j would generate B_1 and it would be regarded as secondary rather than primary field.

   Remark: The flux tubes of B_1 would be obtained from closed string like objects with CP_2 projection which geodesic sphere S^2 by replacing S^2 with disk D^2, by deforming to get flux tube, and gluing it to a large background space-time sheet along D^2. The current creating B_1 would be associated with the boundary of D^2.

One cannot of course exclude the Maxwellian option for B.

1. The portion of flux tubes of B identifiable as analog of the dipole core of Maxwellian dipole field would consist of particles with magnetic moment whereas for monopole flux no magnetic moment is needed. Magnetic moment could be due to spin or orbitals motion.

   Remark: One could wonder whether quantum-classical correspondence (QCC) requires that the monopole flux has as quantum counterpart magnetization representable in terms of fermions.

2. The contribution of the spin to magnetic field is rather small so that the idea about spontaneous magnetization at flux tubes defining dipole does not look promising. Note however that the large value of h_{eff} together with proportionality of $\mu \propto \hbar_{eff}/m$ could change the situation. Macroscopic quantum coherence making possible quantum states with macroscopic radius for the orbits could be considered and would conform with the idea that the flow of currents generates B. B could be of course generated also classically.

8.4 Are wormhole magnetic fields really needed?

The additional assumption is that wormhole magnetic fields involving two space-time sheets connected by wormhole contacts appear in the volume containing B. More generally, fundamental magnetic fields would be wormhole magnetic fields. This additional hypothesis is necessary in the recent model of elementary particles and p-adic fractality suggests that the property holds true also astrophysical scales.

1. In elementary particle scales monopole flux tubes associated with wormhole magnetic fields must be closed and involve return flux along second space-time sheet. If the two space-time sheets have same M^4 projection, the test particle touches both sheets and experiences essentially no gauge fields. At QFT limit one would have no fields. Therefore the M^4 projections of the flux tubes at the two sheets must be disjoint in order that one has normal magnetic field in operational sense.

The energies of both flux tubes however sum up and the wormhole flux tube pair has long range gravitational interactions. The attractive interpretation is that if the volumes in which the sheets have same M^4 projection, the energy of flux tube pair corresponds to dark energy. The portions giving rise to tangles in which the flux sheets have separate projections give rise to ordinary matter. This would give rise to galaxies, stars, and planets and even smaller objects in various scales. Flux tubes would thicken and their energy would decay to ordinary and dark matter.

2. Wormhole magnetic fields could define pairs of systems. The understanding of the geometric correlates for the hierarchy of Planck constants have already led to the realization that many-sheeted space-time means that one space-time surface can be regarded as n_1-fold covering of CP_2 and n_2-fold covering of M^4 such that one has $h_{eff}/h_0 = n = n_1 n_2$ holds true. For n_1-fold covering of CP_2 the sheets can be disjoint regions of M^4. Although the regions are disjoint, they are physically closely correlated. This is classical correlate for macroscopic quantum coherence coded also by the large value of n.

   For $n_1 = 2$ one obtains the simplest pairs. Also even values of $n_1 = 2m_1$ are of course and would describe a pair of structures with m_1 components. The components would be most naturally flux tubes fusing to larger flux tube fractally.

3. This view becomes understandable if one takes CP_2 coordinates or $M^2 \times CP_2$ coordinates as a coordinate system so that the roles of space-time and fields are changed or partially changed. At the level of wormhole contacts the change of the roles of M^4 and CP_2 is necessary. For string like objects $M^2 \times S^2$ replaces M^4. This corresponds to that part of TGD, which does not allow description in terms of GRT.

Playing with the ideas generates questions and new ideas, not always realistic. At this time the question is following.

1. Could the Euclidian region associated with wormhole contact and connecting wormhole throats at the two sheets connect two disjoint, even distant regions of M^4? If so, the wormhole contact would be analogous to Einstein-Rosen bridge except that it has Euclidian signature of the induced metric.

   Could one identify the wormhole contact as a space-time correlate for entanglement or prerequisite for it? There would be no signal involved since in Euclidian space-time regions one cannot talk about propagation. Euclidian flux tubes are in central role in p-adic mass calculations [K13] but they are extremely short.

   I have assumed that time-like flux tubes can serve as correlates of entanglement. Could one can think that Minkowskian flux tubes would allow classical signalling and Euclidian flux tubes would serve as classical correlates for entanglement. Could both aspects be involved with quantum communications?

   Remark: One can obtain Euclidian space-time region from piece of M^4 by performing a large enough deformation in CP_2 directions and also this could give rise to Euclidian induced metric. One can also have cosmic string with piece of M^2 as string world sheet and deformed such that one has flat E^2. The deformation of this string world sheet would represent Euclidian flux tube.

2. Here one must be however extremely cautious. Hitherto I have regarded shortness of flux tubes as obvious, and might have been right. One cannot however exclude the possibility that also Euclidian wormhole contacts are involved but they do not seem to be necessary: one could have wormhole magnetic fields with wormhole contacts only in the regions where M^4 projections overlap. All depends on the properties of preferred extremals.

8.5 How to understand the solar cycle?

Sunspot cycle (see `http://tinyurl.com/y2qlaaa2`) has period of 22 years and consists of two 11 year half-periods during which opposite polarity of B. The understanding of the mechanism causing the flip of the polarity looks the most difficult part of the problem - at least from TGD

point of view. Each half cycle starts from a situation in which the dipole part of B vanishes and sunspots appear at opposite sides of equator at symmetrically related positions at mid-latitudes (about 30 degrees from equator).

Sunspots (see `http://tinyurl.com/y2qlaaa2`) carry intense magnetic fields (fields strength is about 2 Tesla in the vicinity of Sunspot according to Wikipedia) and they have lower temperature than surroundings due to the magnetic pressure. During the half-cycle Sunspots drift towards equator and maintain their polarity. The diagrammatic description of the time evolution at the solar surfaces is known as butterfly diagram. The natural interpretation is that the sunspots at opposite sides are connected by flux loops.

During the cycle the dipole field with opposite polarity as compared to previous cycle is generated and towards the end of the cycle there is a period in which no sun-spots are observed: they would be near equator if present. The spots could be present but the density of elementary flux tubes could be too low to give rise to average field strength enough to cause an observable reduction of temperature.

8.5.1 Polarity reversal of B

What could be behind polarity reversal. First some guiding ideas.

1. An analogy with ferromagnetic hysteresis circuit suggests itself. B generates B_1 having opposite direction. When the value of B_1 is critical it induces a phase transition in which the direction of Kähler flux is changed at flux tubes. Second half of the 22 year sunspot cycle would start. The ohmic current j generated by B would change and this would induce the magnetic turbulence accompanying solar spots.

   This analogy is not quite complete since the generation of B with opposite sign occurs slowly whereas the vanishing of magnetic field isa fast process. De-magnetizing phase transitions seems therefore a natural analog for the dis-appearance of B.

2. What the analog of spin flip means is highly non-trivial question when the size of the analog of spinning particle is of the size scale of Sun. Quantal and topological effect in solar scales could be in question and involve both TGD view about space-time and fields as well as hierarchy of Planck constants as description of dark matter. The model to be described in the sequel applies universally in TGD Universe and leads to quite dramatic and testable implications.

Consider next general TGD inspired ideas relating to the change of the polarity of B in TGD framework. A general model based on the formation of flux tube tangle as a representation of the say dipole field looks like a safe starting point and provides also a general model for the change of the polarity. An essential element is the distribution of incoming flux of long cosmic string like object to fluxes going through the interior and exterior of the dipole core and return back through exterior and interior. The fractions going through interior and exterior determine the strength of observed B. Whether both kinds of flux tubes are present or not, depends on model.

The first model, call it Model I, is classical. Now one could do using only single flux tube type, say type I, which however must divide to flux tubes travelling both inside and outside the dipole core.

1. The decay of B would correspond to option I involving the change of fractions p_1 and $p_2 = 1-p_2$ of the flux tube portions going through the dipole core reducing the parameter p_1-p_2 to zero. The permutations of flux tube portions inside and outside core must lead to $p_1-p_2 = 0$ and one expects that this process continues and changes the sign of $p_1 - p_2$ and therefore induce polarization reversal. The duration of the process taking $p_1 - p_2$ to zero is rather short as compared to the duration of the half-cycle. The duration of the sunspot minimum is about 10 per cent of that for the entire half cycle. In the hydrodynamical analogy the process would be redistribution of the incoming flow and could be modelled phenomenologically as a change of flow resistances associated with the two channels involved.

2. This model does not involve reconnection process and does not provide any obvious explanation for the appearance of sunspots nor for the reconnection process associated with the reversal of the polarization of B. Therefore Model I is not promising.

Second model, call it Model II, is quantum mechanical and involves ZEO in an essential manner and one could assume that incoming flux tube enters to the dipole core entirely (option II).

1. Dipole winding number n_i characterizes the situation for a given type of flux tube. The larger the value of n_i, the larger the dipole strength. n_i could change by reconnection process in which entire dipole loop reconnects and snips away. This followed by further splitting to flux loops would correspond to the emission of magnetic loops from the Sun.

   The opposite process would correspond to a fusion of flux loop with a long flux loop but looks thermodynamically implausible. Also a fusion of a short flux loop with long flux loop and the growth of the reconnected part to large dipole loop looks implausible.

2. Could ZEO based quantum TGD allowing temporary time reversals come in rescue? At dark space-time sheets one can indeed imagine the possibility of time reversals. Ordinary matter would be controlled by dark matter with larger value of $h_{eff}/h_0 = n$ serving as an IQ in TGD inspired theory of consciousness, and would be forced to follow the leader in conflict with its thermodynamical instincts. Could the process involve "big" state function reduction (BSR) and could the dominance of flux tubes of type I and II correspond to different arrows of time at the level of dark flyx tubes? Reconnections for flux loops of say type II would occur in time direction opposite to the standard direction of time but second law would hold true in generalized sense.

3. The simplest option is that all incoming flux enters to the interior of the dipole core ($p_{2,I} = 0$ identically) or to its exterior ($p_{1,I} = 0$) identically. The first looks more plausible. The integers n_i, $i = \{I, II\}$ characterize the numbers of dipole flux loops carrying magnetic fields with opposite polarizations. Dipole strength is proportional to $n_I - n_{II}$. The arrows of time at the two sheets are assumed to be opposite for flux tube of type I and II.

4. Consider now a model for the first half-cycle.

   (a) Assume for definiteness that in the initial situation one has ($n_I = n_{max}, n_{II} = 0$). B as maximum value B_{max}.

   (b) The transition leading $B = B_{max}$ to $B = 0$ would be "big" state function reduction (BSR) changing the arrow of time at sheets of both type I and II. BSR would generate maximum number of new dipole flux loops of type II: $n_{II} \to n_{max}$ so that one has $n_I = n_{II} = n_{max}$ and $B = 0$.

   This transition is clearly a quantum analog of spontaneous magnetization in sector II. Could one say that a spontaneous magnetization already present in sector I induces opposite spontaneous magnetization in sector II?

   Quantum classical correspondence (QCC) inspires the question about there is in the fermionic sector genuine spontaneous magnetization involving fermion spins. Could a formation cyclotron condensate of spin zero Cooper pairs with members at flux tubes of type I and II and having opposite spins accompany this process?

   (c) After that dipole loops of type I begin to split away by reconnections in "small" state function reductions (SSRs) so that n_I decreases. They split further in pieces and leak out from Sun. Net B increases until one has $B = -B_{max}$. This process is analogous to gradual decay of magnetization.

   (d) What looks strange that n_{II} would remains unchanged during this process. In ZEO this makes sense: it would corresponds to the passive boundary of causal diamond (CD). One would have two CDs having common portion of boundary, call it δCD. Since the arrows of time are opposite, $\delta CD \subset \delta CD_{II}$ would be passive and experience generalized Zeno effect whereas $\delta CD \subset \delta CD_I$ for CD_I would be active experiencing gradual decay of magnetization in the sequence of "small" state function reductions (SSRs).

   (e) Topologically one can understand the sunspot cycle in terms of split dipole loops leaving the Sun: their intersection with the solar surface would define sunspot pair and the distance of members of the pair would decrease to zero during the cycle.

5. The model for the second half-cycle is identical. First occurs BSR generating maximum number of new flux loop portions of type I leading $n_I = n_{II} = n_{max}$ and $B = 0$ and same is repeated except that now n_{II} decreases.

The classically highly counter-intuitive aspect of this picture is that dipole loops would appear in BSR as quantum leap in astrophysical scales. There would be no continuous time evolution generating additional dipole loops. Their dis-appearance by reconnections would correspond to classical time evolution. If one performs time reversal for thermodynamic intuition, there is nothing mystical involved.

Model II looks to me more promising -if not even the only possibility - although conservative colleague can criticize it for the speculative new physics features: these features are however basic elements of new physics predicted by TGD.

8.5.2 Sunpots as intersections of split dipole flux loops with the Earth's surface?

How could sunspots be understood in the picture suggested by Model II?

1. BSR would induce the cancellation of B. Sunspots should emerge after the cancellation and serve as a signature of BSR inducing change of the arrow of time at flux tube space-time sheets. The usual statement is that the density of the elementary flux tubes composing the the split flux loop is high enough the average magnetic pressure lowers the temperature so much that the solar spot becomes visible.

   Could the local reduction of temperature inside sunspots, something not expected in the naïve thermodynamical thinking be forced by the change of the arrow of time at dark flux tubes? One would have leveling of temperature differences but in opposite time direction induced by dark flux tubes having arrow of time opposite to the standard one: by dark flux tubes of type I during first half-cycle and flux tubes of type II during second half-cycle.

2. The appearance of sunspots would relate naturally to the reconnection process leading to the disappearance of the dipole loops Do the snipped flux loops, which can split further to pieces eventually leaving Sun, intersect its surface at the sunspots so that the formation of sunspot and its disappearance would correspond to a splitting of closed dipole loop by reconnection and further splitting to smaller loops.

   The motion of sunspots towards equator would correspond to the outwards motion of the split flux dipole loop and solar spots would represent its intersection with solar surface. This also explains why the number of sunpots is gradually reduced during the half-cycle.

3. The fact that sunspots emerge first at latitudes $\pm\pi/6$ means that the split dipole flux loop intersects Earth's surface at positions with distance $h = R_E/2$ from equator. Since the distance is reduced after that, the outward motion of the loop requires that dipole core has height smaller than R_E.

Also in the case of Earth's magnetic field an analogous quantum picture might apply [**?**] and solar spots might have "Earth spots" as magnetic anomalies. What is fascinating that the reversals of the Earth's magnetic field would be quantum processes in the scale of entire Earth and the magnetic field would go to zero instantaneously. What this means for living systems is an interesting question to ponder.

8.5.3 Does the polarity inversion involve spatial inversion?

Assume that the flux tubes correspond to monopole flux tube, which defines two-sheeted wormhole magnetic field. There is a strong temptation to assume that the members of the pairs defined by portions of flux tubes of given type (I or II) in the interior and exterior of dipole core are related by an approximate symmetry. If so, one would have doubles or mirror pairs of systems. What kind of symmetry polarity inversion for the solar B could correspond?

1. Assume that the two flux tube sheets of wormhole magnetic field have M^4 projections with empty intersection. Polarization reversal could permute the positions M^4 projections of the

two sheets of flux tubes turning the direction of the magnetic flux. If the space-time surface representable as a map from CP_2 to M^4, the flip could be understood as a reflection in CP_2 degrees of freedom permuting the M^4 images and represented also as a reflection or inversion in M^4. In adelic physics [**?**, **?**] Z_2 has interpretation as subgroup of Galois group.

2. Could the solar magnetic field be doublet structure mapped to itself under Z_2? The identification of the pair as being formed by symmetry related parts of the flux dipole tubes in the interior of Sun and outside it is what comes naturally in mind. The symmetry could be realized as inversion with respect to the surface of Sun mapping inside and outside to each other. Inversions are indeed symmetries of Maxwell's theory, gauge theories, and of twistor Grassmannian approach. Also for $n_1 = 2m_1$ m_1 could correspond to a subgroup of CP_2. One would have double of bundles formed from m_1 flux tubes: dipole flux tuve consisting of m_1 elementary flux tubes.

3. The symmetry involved need not always be inversion. It could be also spatial reflection. The possibility of higher values of $n = n_1 n_2$, $n_1 = 2m_1$ suggests the possibility of long range correlations between m_1 pairs in astrophysical scales manifesting themselves quite concretely.

4. The representability of the group permuting flux tubes as finite discrete subgroups of $SO(3)$ acting as symmetries of Platonic solids would be very natural, and one can ask whether the appearance of Platonic solids in biology reflects this. This might allow to get some idea about why icosahedral model of harmony in terms of Hamiltonian cycles leading to the notion of bio-harmony predicts correctly genetic code [**?**].

8.6 Trying to understand solar gamma ray spectrum in TGD Universe

One can try to understand the observations about gamma rays [E5, E4] (see `http://tinyurl.com/yxajyzp8` and `http://tinyurl.com/y2qlaaa2`) in the proposed picture. Some kind of acceleration mechanism suggests itself strongly.

1. An electric field associated with flux tubes with helical magnetic field is the simplest option. TGD allows simple deformations of flux tube like solutions [K33] in which Kähler magnetic and electric fields are orthogonal and helical and one can hope that they define preferred extremals.

   What about the electric force experienced by a test particle when the flux tubes of type I and II having same M^4 projection? The identification these objects in terms of dark energy would suggests that also the net electric force cancels and this kind of flux tube pair serves as a kind of superconducting wire.

2. If the flux tubes and gamma rays are dark with large $h_{eff}/h_0 = n = n_1 n_2$, they can propagate without interactions with ordinary matter. The dissipation would be solely due to curvature, in particular the kinks of the flux tube but would not be present at rectilinear portions of the flux tube. Therefore the amount of dissipation would be small.

   Forgetting the losses caused by the curvature of the flux tube, there would be maximum energy $E = ZeV$, V the voltage along flux tube section to which the particles such as protons can be accelerated, and this would define cutoff energy for the emitted gamma rays. I have proposed that this kind of model explains also the gamma rays associated with lightnings [K3].

3. The dip in the spectrum suggests at least two energy scales for accelerated particles emitting gammas as brehmstrahlung and defining the endpoint of the brehmstrahlung spectrum. The explanation that comes in mind is that particles can go through several cycles of acceleration along closed dipole flux tubes and emit gamma rays at kinks. This would give rise to energy bands labelled by the number of acceleration cycle. The possibility of saturation looks plausible. One would have particle accelerator analogous to storage ring. What would be new as compared to LHC would be quantum coherence in the scale of accelerator. For the values of h_{eff} involved the dark particles would have Compton lengths of the order of the size of Sun.

4. How could the charged particle and gamma rays emerge from the flux tubes? One can start from everyday experience. Car can fall off the road in sharp curve. Now the sharp curve would correspond to a kink in flux tube. By momentum conservation there should be a large exchange of momentum with the flux tube to keep the charged particle at the flux tube and this is improbable for sharp kinks. Since the charged particles are relativistic and gamma rays must be directed to the observer, the change of momentum direction must be large. In any case, this requires a large exchange of momentum with the collective flux tubes degrees of freedom. It is quite possible that several gamma rays are emitted at the kink. The charged particle can also leak out.

   A proper description of the situation might be in terms of dark cyclotron states. If the TGD view about dark matter as $h_{eff}/h_0 = n = n_1 n_2$ phases is true on can treat the bundle of flux tubes as single quantum coherent entity. In particular, the solar spots could be identified as this kind of quantum coherent flux tube bundles and n_2 could correspond to the number of elementary flux tubes.

5. The sharp kinks appear at two places. Near the North pole where dipole field lines/flux tubes make a sharp kink. Due to differential rotation the flux tubes associated with the dipole contribution follow the rotation of equator and develop tentacles. The shape of strongly flattened square implies instability against splitting of the tentacles and decay to flux loops by reconnection. This part of the magnetic field decays and leads to magnetic turbulence. Also in the standard picture differential rotation is expected to induce reconnections of field lines. The kinks at the ends would induce emission of gammas and leakage of charged particles. Even single gamma ray could be enough.

   Gamma radiation indeed has two components. Polar component is roughly constant and the equatorial component having sharp maximum during sunspot minimum.

   Spectral index is different for the energy distributions for cosmic rays and gamma rays from Sun: solar distributions are harder. Also the equatorial distribution is harder than polar distribution. One expects that the distribution depends on the energy of the gamma ray and on the sharpness of the kink. In the case of polar distribution two gammas is minimum whereas for equatorial distribution single ray can be enough. This softens the polar distribution as compared to equatorial one. Since several loops are possible even the cosmic ray distribution for charged particles can harden.

Where could the charged particles originate?

1. The basic observation is that flux of gammas is 5 times higher than predicted by the model identifying them as cosmic rays reflected in solar magnetic field fails. Roughly the same order of magnitude suggests that cosmic gamma rays could be the origin. Spectral distribution does not support this idea.

2. Charged particles could come from the solar core or along the long thickened cosmic string continuing as flux tubes of the magnetic field. Cosmic string would not accelerate the charged particles but only feed in the particles beams as kind of supra currents. Also cosmic rays could enter the flux tubes as assumed in the original model: in fact, cosmic rays would naturally arrive along the long flux tubes connecting Sun to sources of cosmic rays.

   This could explain why the upper bound for gamma ray energies for cosmic rays equals to the maximal detected energy (100 GeV). Instead of being reflected cosmic rays could rotate possibly several times around dipole flux tube and leak out in the kink. The emission of gamma rays at kinks reduces the energy gain for simple loop and for higher number of loops the reduction is larger. Saturation is quite possible.

3. The origin of galactic rays is still a mystery (see `http://tinyurl.com/psdp99h`). One proposal is that they originate from neutron stars. The proposed acceleration mechanism could be at work in the case of neutron stars so that neutron star could indeed provide the charged particles. As discussed there are also other options.

8.7 Surprises about the physics at the boundary of the heliosphere

I learned from interesting results about cosmic rays and behavior of magnetic field at the boundary of heliosphere (see the article "*Voyager Mission Reveals Unexpected Pressure at The Edge of The Solar System*" (see `http://tinyurl.com/y474zww4`). The article "*Pressure Runs High at Edge of Solar System*" (see `http://tinyurl.com/y5t258c8`) gives a more precise description of the findings.

There were two spacecrafts. Voyager2 was inside heliopause ad Voyager1 slightly outside it. They experienced different kind of reduction in cosmic ray flux. I picked up the following piece of text explaining the basic findings.

> *The scientists noted that the change in galactic cosmic rays wasn't exactly identical at both spacecraft. At Voyager 2 inside the heliosheath, the number of cosmic rays decreased in all directions around the spacecraft. But at Voyager 1, outside the solar system, only the galactic cosmic rays that were traveling perpendicular to the magnetic field in the region decreased. This asymmetry suggests that something happens as the wave transmits across the solar system's boundary.*

Consider first TGD based view about magnetosphere of Sun.

1. TGD allows two kinds of magnetic fields: those for which flux tubes carry monopole flux and those for which they do not. Monopole flux tubes are impossible in Maxwellian world and solve several problems related to magnetic fields such as the existence of magnetic fields in cosmic scales, and the maintenance problem of the Earth's magnetic field [**?**]

   One of the latest applications is to the undertanding of the weird properties of the magnetic field of Mars identified in the model as consisting of monopole flux tubes [**?**] and thus visible only through northern and southern lights involving reconnections of the monopole flux tubes. Also Mercury has unexpectely strong magnetic field and it could correspond to monopole flux tube tangle associated with flux tubes from Sun.

   The latest application is to a model of earthquakes and volcanic eruptions [**?**] known to be induced by cosmic rays but quite too deep for them to penerate to the depths required. There is strong correlation with solar minima and it has turned out that the solar minimum corresponds to maximum of magnetic field. There is also a causal anomaly: electromagnetic fluctuations in upper atmosphere precede rather than follow these event. The new view about magnetic fields and zero energy ontology predicting that arrow of time changes in "big" (ordinary) state function reductions explains these anomalies. Causal anomalies involving change of also thermodynamical arrow of time are a generic signature of macroscopic state function reductions in TGD Universe.

2. Also a new view about cosmic rays emerges. Cosmic rays would travel along flux tubes of a gigantic fractal flux tube network defining analog of nervous system for the Universe [**?**]. This picture leads to a rather detailed model for the formation of galaxies, stars and even planets as tangles along the flux tubes of this network having same topological structure as dipole magnetic field but with flux tubes carrying monopole flux [**?**].

3. In TGD framework heliosphere corresponds to magnetically to U-shaped tentacles from Sun - flux tubes emanating from Sun radially and returning back to Sun and carrying solar wind and also cosmic rays. They look locally like parallel flux tubes carrying opposite magnetic fluxes. Flux tubes would extend to the heliopause and turn back and emit by reconnection narrow rectangle shaped closed flux tubes.By fractality these tentacles appear in all scales and are in crucial role in understanding of bio-catalysis and basic biochemical reactions like DNA replication, transcription of DNA to RNA, and translation of RNA to polypeptides.

4. Cosmic rays can travel as dark particles along them in TGD sense meaning that they would have effective Planck constant $h_{eff} = n \times h_0$, where h_0 is minimal value of h_{eff}. The flux tubes from Sun would thus bring dark particles along flux tubes. Suppose that the flux of cosmic rays arrive along these flux tubes, perhaps as dark particles.

Next one must translate various words to physical concepts in TGD framework.

1. Heliosheath (Voyager 2) is expected to be a turbulent boundary region. Magnetic turbulence means that the directions of U-shaped flux tubes coming from Sun are random. This is magnetic counterpart of a boiling liquid.

   Closed U-shaped flux tubes from Sun reach the heliopause before reconnection meaning emission of closed flux tubes looking like narrow rectangles travelling in radial direction: the direction of the flux is assumed to be along the radial flux tube and two directions are possible.

2. The region outside heliopause (Voyager 1) contains two kinds of monopole flux tubes, which need no current for their existence. Those of galactic magnetic field locally parallel to heliopause like in liquid flow around obstacle plus the closed flux tubes as outcomes of reconnection. They are assumed to be narrow rectangle-like objects in radial direction coming from the heliopause. There are also flux quanta of ordinary magnetic field generated by currents.

3. The wave called global merged interaction region (GMIR) caused by the activity of Sun means reconnections for the U-shaped flux tubes from the Sun at solar surface generating ordinary magnetic fields giving rise to sunspots. This reduces the number of U-shaped flux tubes and therefore also solar wind and the amount of cosmic rays arriving along them. Thus the reduction of solar wind and of cosmic rays both inside and outside heliosphere.

4. If the local directions of solar flux U-shaped tubes inside heliosheath are random by turbulence the reduction of flux takes place in all directions. It the long sides of closed flux tube rectangles are radial (orthogonal to the dominating galactic magnetic field), the reduction of flux takes place only in directions orthogonal to the galactic magnetic field. This was observed.

5. The high pressure could be due to the presence of closed flux tubes formed in reconnection and would represent the contribution of solar wind.

8.8 About general implications of the pairing hypothesis

If wormhole magnetic fields appear in all scales, flux tube pairs and more general $n_1 = 2m_1$ multiplets of flux tubes decomposing to m_2 pairs should be universal aspect of the dynamics of TGD Universe. In the following the implications are considered only briefly. The basic consequence is of course that Universe becomes in all scales a quantum coherent object and the locality hypothesis of classical physics would be simply wrong.

8.8.1 Elementary particle physics

Wormhole magnetic fields appear already in elementary particle physics. Elementary particles correspond to at least 2-sheeted flux tube structures with wormhole throats containing the boundaries of string world sheets carrying fundamental fermions. I have already earlier considered the possibility that the M^4 projections of the sheets are disjoint.

Remark: In the general case one would have $n_1 = 2m_1$. Color symmetry for quarks could have as a remnant $m_1 = 3m_3$. For leptons m_1 would not be divisible by 3. Since n_1 corresponds to discrete subgroup for $SU(3)$, m_1 could correlate with the triality of $SU(3)$ partial wave defining the color quantum numbers of the particle.

8.8.2 Astrophysics and cosmology

The predictions in astrophysics and cosmology are in strong conflict with the locality principle of classical physics.

1. The model for magnetic spin flips in solar cycle leads to the conclusion that solar magnetic field could have doublet structure with parts related by inversion with respect to solar surface. Could the entire MB of Sun have copy somewhere. In principle this is an experimental question. The copy would be connected to Sun by wormhole magnetic flux tubes and this suggests long range correlations.

   Stars indeed very often appear as binaries (see `http://tinyurl.com/oooagma`). Could these pairs be related by approximate CP_2 symmetry inducing reflection of inversion in M^4? Could

the planets of mirror paired stars be related by Z_2? Could there be correlations between the rotation planes for instance.

2. What about Earth could be invariant under inversion so that the radius of Earth could define the radius remaining invariant under inversion. This could make Earth so special as far as life is considered.

   Could Earth have a double in longer length scale? The least science fictive candidate would be another planet.

   Mars (see `http://tinyurl.com/mttm7h8`) has radius $.53R_E$, which is the radius that Earth would have had before the Cambrian Explosion according to TGD inspired variant of Expanding Earth model [**?**]. Mass is 11 per cent of the Earth's mass. There are indications for life in Mars. Venus (see `http://tinyurl.com/72rz2g2`) has characteristics surprisingly near to those of Earth except that rotation is in opposite direction than for Earth: the rotation period is -243.025 days. The distances from Sun for (Venus,Earth,Mars) triplet are $(.72, 1.00, 1.52)$ AU. Could Venus and Mars form a mirror pair with respect to inversion at radius R_E.

   Recently Nasa found an exoplanet christened as Gliese 581d (see `http://tinyurl.com/yxdmpnbj` and `http://tinyurl.com/y2bwco6q`) located in constellation Lyra at distance of only 20.4 light years. The planet is almost exact copy of Earth as far the prerequisites of life are considered. Semimajor axis of the orbit is .22 from that of Earth. Mass is about 6.98 times higher than Earth mass, the radius is $2.20R_E$. The Sun of the planet could be mirror image of Earth: if this is the case, the should be correlations such as common rotation planes.

3. I have considered [**?**] also a model for the changes of the orientation of Earth's magnetic field involving the interaction of monopole flux tubes and ordinary magnetic field via magnetic torques, and the solar model probably generalizes almost as such. Now however the orientation of the magnetic field can vary. This could relate to the fact that the axis of rotation differs from the magnetic axis. Again inversion as an approximate symmetry is suggestive.

4. The most intriguing finding about CMB spectrum is anomaly known as "Axis of Evil" (see `http://tinyurl.com/yb6nabw4`). The anomaly appears to give for the plane of planetary system of Sun and the location of Sun a greater significance that one might expect by change. This violates the Copernican Principle. The effect resembles selection of spin quantization axis in quantum measurement of spin performed by the measurer. A possible explanation at the level of space-time is that by $h_{eff}/h_0 = n$ hierarchy disjoint space-time sheets even in cosmic length scales are related by discrete CP_2 symmetries implying correlations.

8.8.3 Biology

The binary structures populating biology might correspond to pairs of monopole flux tubes. The original motivation for the proposal that they are important comes from p-adic length scale hypothesis: primes $p \simeq 2^{k+2}$ and $p \simeq 2^k$, where k and $k+2$ are twin primes, could define structures with size scale $L(k+2)$ decomposing to a pair of structures with size scale $L(k)$ [K4]. The structures of twin pair would form quantum entangled structures.

1. DNA and RNA double strands are basic examples of these structures. Even single DNA and RNA molecules form mirror pairs with their conjugates and could be connected by long wormhole contacts. This would make them quantum coherent structures making possible the mysterious ability of bio-molecules to find each other in the molecular crowd. Bio-systems would be extremely organized structure rather than a soup of randomly moving molecules. Could this kind of symmetries characterize all molecules that are paired or form higher structures with $n_1 = 2m_1$?

2. Cell membranes are formed by pair of lipid layers and also these could be twin pair. Epithelial sheets consist of two cell layers. At the level of body and brain there is also a pairing of subs-structures in left and right brain. Pineal gland is a connected structure could itself be a pair. Also brain hemispheres form a pair. Even married (or even non-married!) couple could

form this kind of pair and what looks like a random personal relationship could be something much deeper.

3. All multi-molecular structures in living matter at least could correspond to groups of n_1 disjoint space-time sheets, perhaps magnetic flux tubes. The value of n_1 would serve as a measure for the scale of coherence and complexity.

4. Inversion corresponds to the inversion of the polarity of the Earth's magnetic field but might happen also at the cell level. In biology involution turning cell inside-out occurs during the gastrulation phase (see `http://tinyurl.com/y4pvpxyr`) of the embryonic development and leads to a development of 2 (ectoderm,endoterm) or 3 cell layers (ectoderm, mesoderm, endeterm) giving later rise to different types of tissues. This process looks rather mysterious - at least to me. Could involution be induced by the inversion of the magnetic body of the developing embryo?

5. MB controls (also our) biological body (BB) and uses scaled variants of EEG consisting of dark photons for this purpose [K7]. It is natural to assume that our MB corresponds to the part of MB above the Earth's surface. If Z_2 acts as inversion with respect to the surface of Earth then also the part of MB below the surface of Earth should correspond to an intentional agent.

   Could these MBs be associated intra-terrestrials ITs or could they control same BBs as our usual MBs? Here one must consider the precise definition of inversion: is it with respect to the surface of Earth or the boundary of the dipole core of the Earth's B? Taking inversion in the first sense of the definition very literally, one could argue that plants having also roots are inversion invariant but animals are strictly speaking not inversion invariant in either sense. Therefore we would have separate personal mirror MBs and also BBs: analogs of Dr. Jekyll and Mr. Hyde. In fact, I have have-jokingly considered a model for crop circles, and this led to a crazy idea about IT life [K5, K6]. Could this idea be not so crazy as it looks first? Accepting dark matter as $h_{eff}/h_0 = n$ phases, the high temperature in Earth interior ceases to be an objection.

6. $n_1 = 2m_1$ implies also that conscious entity can have n_1 disjoint pieces. They could be MBs controlling the same BB (multiple personality disorder) or maybe even separate BBs. Could these possibly distinct BBs locate at different sides of globe or even cosmos? What comes in mind Kieslowski's trilogy "Three colors". When the connection between hemispheres is destroyed, brain hemispheres controlling different body halves would live effectively separate lives, and could even fight for the control of BB. This gives some ideas as one tries to image what it is to have several BBs. It is interesting that in dreams we often have different identities than in wake-up state.

8.8.4 Consciousness

The existence of twin pairs might have profound implications for consciousness [**?**, **?**].

1. I proposed for about 2 decades ago what I called magnetospheric consciousness [K12, K11, K5, K6]. The MB of not only Earth but also our MB would have parts assignable to the interior and exterior of the Earth. Even the structures of brain should have a scaled up MB image at both levels. The approximate inversion symmetry brings in exciting additional aspects. Maybe this division could provide the physical correlates for the Heaven-Hell dualism of religions and "as above-so below" dualism of perennial world views and mysticism.

2. Interior-exterior divisions are central for consciousness and the hierarchy of conscious entities in correspondence with the hierarchy of space-time sheets inspires the question whether also our biological bodies and environment could be related by an approximate symmetry at the level of MB at least so that one could speak of MBs assignable to the interior and exterior of BB. The sensory representations would reflect this approximate symmetry. Subsystem able to remain entangled at the passive boundary of CD defines the permanent part of self. But also its complement remains unentangled and should define permanent part of self: does this mean that the world outside me is a conscious entity?

3. One of the most dramatic predictions of TGD inspired theory of consciousness based on zero energy ontology (ZEO) is re-incarnation of self in death as a time-reversed self. There is indirect support for this: for instance, mental images identified as sub-selves die and re-incarnate and the period during which they are absent would correspond to the life with opposite arrow of time.

   Where could these ghostly time-reversed re-incarnations live? Or putting it more formally: what regions of space-time surface do these entities control and receive sensory input from? Could inversion with respect to Earth's surface relate the space-time regions associated with self and its time reversal. If personal MB is part of MB above the Earth's surface, its inversion would be the part of MB below it. When we die we get buried. Could this ritual reflect the sub-conscious idea that our life continues as IT lifeform?

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