

Time, Spacetime, and Consciousness

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Abstract

This article is devoted to the TGD based view about time, space-time, and consciousness. The article begins with an updated view about the notions of many-sheeted space-time and topological field quantization taking remote metabolism as an example about the new biophysics made possible by negative energy MEs and many-sheeted space-time.

The TGD based view about time and intentionality is analyzed. The basic new result is the characterization of intentionality as a local randomness combined with long range temporal correlations realized in terms of p-adic fractal statistics involving the breakdown of the ordinary real statistics. The elegance of the model is that long range correlations reflecting intentionality reduce to p-adic continuity: very distant space-time points can be very close p-adically. This characterization allows to experimentally differentiate between intentionality and genuine randomness and determine the p-adic prime characterizing the intentional system without any model dependent assumptions. The astrophysical real size for the p-adically small space-time sheets representing intentions justifies the assumption about astrophysical sizes of the personal magnetic body and MEs meaning the most dramatic deviation between TGD based and standard view about living matter.

The TGD inspired view about time and brain is compared with the neuroscience based vision. The time delays related to passive and active aspects of consciousness discovered by Libet are shown to support the notion of magnetic body having astrophysical size. The general model for the intentional action allows to understand sensory perception, motor action, and memory as special cases of the mechanism for which the personal magnetic body is the intentional agent and motor action proceeds from long to short length and time scales. The intention represented by a p-adic ME is transformed to a negative energy ME representing the desire about the action and entangling the magnetic body with some lower level in the hierarchy. The cascade of intentions transformed to desires eventually reaches the material body and induces the desired action as a reaction in the geometric past communicated classically to the geometric future. Brain only reacts to the desires quantum communicated from the geometric future, which explains the coherence of motor action difficult to understand if brain genuinely plans and initiates the action. Also remote mental interactions are based on the same mechanism and precognition and long term memory as well as PK and retro PK can be seen as different aspects of the same phenomenon.

The model predicts four types of memories corresponding to cyclotron transitions of protons and electrons and Z^0 cyclotron transitions of neutrons and neutrinos identifiable as long term sensory and motor memories (p,n), short term sensory memories (e), and cognitive working memories (ν). Some models for long term memories are discussed and only the so called time-mirror mechanism is found to be consistent with the identification of the magnetic body as experiencer. A precise realization of the time-mirror mechanism based on spin glass degeneracy is identified.

1 Introduction

In this article I will discuss TGD based view about time and space-time. The discussion of the many-sheeted space-time concept explaining the basic notions once again is included because I feel that this is in order since the understanding of "topological light rays" (massless extremals, briefly MEs), and of magnetic and electric flux quanta has developed vigorously since the articles published in the last issue of JNLRMI [5]. I have not even attempted to include all essential aspects since this would simply lead both me and the reader to despair. I consider those aspect that I feel especially relevant just now. To be honest, the act of writing the article generated a lot of new insights and ideas so that the boring duty to summarize something already done transformed once again to an active process of thinking and identifying weak points in the existing scenario and trying to see the idea landscape from a more general perspective. The four online books at my homepage [1, 2, 3, 4] provide comprehensive unavoidably out of date summary of TGD and TGD inspired theory of consciousness. The chapters "Time and Consciousness" and "Quantum model of memory" of [3] contains more detailed and complementary discussions about time and consciousness.

A brief summary of what might be called basic principles is in order to facilitate the reader to assimilate the basic tools and rules of intuitive thinking involved.

1.1 Quantum-classical correspondence

The fundamental metalevel guiding principle is quantum-classical correspondence (classical physics is an exact part of quantum TGD). The principle states that all quantum aspects of the theory, which means also various aspects of consciousness such as volition, cognition, and intentionality, should have space-time correlates. Real space-time sheets provide kind of symbolic representations whereas p-adic space-time sheets provide correlates for cognition and intentions. All that we can symbolically communicate about conscious experience relies on quantal space-time engineering to build these representations.

1.2 Classical physics as exact part of quantum theory

Classical physics corresponds to the dynamics of space-time surfaces determined by the absolute minimization of so called Kähler action. This dynamics have several unconventional features basically due to the possibility to interpret the Kähler action as a Maxwell action expressible in terms of the induced metric defining classical gravitational field and induced Kähler form defining a non-linear Maxwell field not as such identifiable as electromagnetic field however.

1.2.1 Classical Z^0 and color fields

Geometrization of classical fields means that various classical fields are expressible in terms of imbedding space-coordinates and are thus not primary dynamical variables. This predicts the presence of long range Z^0 and color (gluon) fields not possible in standard physics context. The classical Z^0 force and its neutrino screening justify the approximate treatment of atoms as hard balls crucial for understanding condensed matter stability and for the notion of valence in standard chemistry. The quantum control of neutrino screening of the classical Z^0 force provides a basic mechanism of enzyme action explaining the associated chiral selection and is a key player in the prebiotic evolution [D11]. Classical color force in turn is the backbone in the model of color vision [D7]: colors correspond to increments of color quantum numbers in this model.

1.2.2 Topological field quantization and the notion of many-sheeted space-time

The compactness of CP_2 implies the notions of many-sheeted space-time and field quantization. Topological field quantization means that various classical field configurations decompose into topological field quanta. One can see space-time as a gigantic Feynmann diagram with lines thickened to 4-surfaces. Absolute minimization of Kähler action implies that only selected field configurations analogous to Bohr's orbits are realized physically so that quantum-classical correspondence becomes very predictive. An interpretation as a 4-D quantum hologram is a further very useful picture [D4] but will not be discussed in this article in any detail.

Topological field quantization implies that the field patterns associated with material objects form extremely complex topological structures which can be said to belong to the material objects. The notion of field body, in particular magnetic body, typically much larger than the material system, differentiates between TGD and Maxwell's electrodynamics, and has turned out to be of fundamental importance in the TGD inspired theory of consciousness. One can say that field body provides an abstract representation of the material body.

One implication of many-sheetedness is the possibility of macroscopic quantum coherence. Each space-time sheet carrying matter has a temperature determined by its size and the mass of the particles residing at it via de Broglie wavelength $\lambda_{dB} = \sqrt{2mE}$ assumed to define the p-adic length scale by the condition $L(k) < \lambda_{dB} < L(k_>)$. Large space-time sheets are macroscopic quantum systems and therefore ideal sites of the quantum control in living matter. Many-sheeted space-time predicts also fundamental mechanisms of metabolism based on the dropping of particles between space-time sheets with an ensuing liberation of the quantized zero point kinetic energy. Also the notion of many-sheeted laser follows naturally and population inverted many-sheeted lasers serve as storages of metabolic energy [D3].

Space-time sheets topologically condense to larger space-time sheets by worm-hole contacts which have Euclidian signature of metric. This implies causal horizon at which the signature of the induced metric changes from Minkowskian to Euclidian. This forces to modify the notion of subsystem. What is new is that two systems represented by space-time sheets can be unentangled although their subsystems bound state entangle with the mediary of the join along boundaries bonds connecting the boundaries of sub-system space-time sheets. This is not allowed by the notion of subsystem in ordinary quantum mechanics. This notion in turn implies the central concept of fusion and sharing of mental images by entanglement.

1.2.3 The possibility of negative energies

A further prediction derives from the fact that space-time is 4-surface rather than an abstract manifold. Energy momentum tensor of general relativity is replaced by a collection of conserved energy and momentum currents, which are 4-vector fields. This makes the notions of energy and momentum precisely defined but also implies that the sign of energy and momentum depend on the time-orientation of the space-time sheet. Negative energies become therefore possible somewhat like in the lines of a Feynmann diagram. Negative energy topological light rays have phase conjugate laser waves [7] as the most plausible standard physics counterparts, and play a fundamental role in quantum metabolism as a kind of quantum credit card [D3]. They generate also timelike entanglement which corresponds to a formation of new kind of bound states.

Negative energies might be possible even for ordinary particles and could mean dramatic deviation from the standard quantum theory. The roles of annihilation and creation operators have changed for negative energy space-time sheets. This would mean that operator combinations involving both annihilation and creation operators would generate states involving positive and negative energy space-time sheets. One can even imagine that a intentional action could create states with vanishing net quantum numbers and that positive and negative energy particles could be separated from each other.

1.2.4 TGD Universe is quantum spin glass

Since Kähler action is Maxwell action with Maxwell field and induced metric expressed in terms of $M_+^4 \times CP_2$ coordinates, the gauge invariance of Maxwell action as a symmetry of the vacuum extremals (this implies is a gigantic vacuum degeneracy) but not of non-vacuum extremals. Gauge symmetry related space-time surfaces are not physically equivalent and gauge degeneracy transforms to a huge spin glass degeneracy. Spin glass degeneracy provides a universal mechanism of macrotemporal quantum coherence and predicts degrees of freedom called zero modes not possible in quantum field theories describing particles as pointlike objects. Zero modes are identifiable as effectively classical

variables characterizing the size and shape of the 3-surface as well as the induced Kähler field.

1.2.5 Classical and p-adic non-determinism

The vacuum degeneracy of Kähler action implies classical non-determinism, which means that space-like 3-surface is not enough to fix the space-time surface associated with it uniquely as an absolute minimum of action, and one must generalize the notion of 3-surface by allowing sequences of 3-surfaces with timelike separations to achieve determinism in a generalized sense. These "association sequences" can be seen as symbolic representations for the sequences of quantum jumps defining selves and thus for contents of consciousness. Not only speech and written language define symbolic representations but all real space-time sheets of the space-time surfaces can be seen in a very general sense as symbolic representations of not only quantum states but also of quantum jump sequences. An important implication of the non-determinism is the possibility to have conscious experiences with contents localized with respect to geometric time. Without this non-determinism conscious experience would have no correlates localized at space-time surface, and there would be no psychological time.

p-Adic non-determinism follows from inherent non-determinism of p-adic differential equations for any action principle and is due to the fact that integration constants, which by definition are functions with vanishing derivatives, are not constants but functions of the pinary cutoffs x_N defined as $x = \sum_k x_k p^k \rightarrow x_N = \sum_{k < N} x_k p^k$ of the arguments of the function. In p-adic topology one can therefore fix the behaviour of the space-time surface at discrete set of space-time points *above* some length scale defined by p-adic concept of nearness by fixing the integration constants. In the real context this corresponds to the fixing the behaviour *below* some time/length scales since points p-adically near to each other are in real sense faraway. This is a natural correlate for the possibility to plan the behaviour and p-adic non-determinism is assumed to be a classical correlate for the non-determinism of imagination, cognition, and intention.

These two non-determinisms allow to understand the self-referentiality of consciousness at a very general level. In a given quantum jump a space-time surface can be created with the property that it represents symbolically or cognitively something about the contents of consciousness before the quantum jump. Thus it becomes possible to become conscious about being conscious of something. This is very much like mathematician expressing her thoughts as symbol sequences which provides feedback to go the next abstraction level.

Classical and p-adic non-determinisms force also the generalization of the notion of entanglement. Time-like entanglement, crucial for understanding long term memory and precognition becomes possible. The notion of many-sheeted space-time forces also to modify the notion of subsystem, which implies that

unentangled systems can have entangled subsystems. One can partially understand this in terms of length scale dependent notion of entanglement (the entanglement of subsystems is not seen in the length scale resolution defined by the size of unentangled systems) but only partially. The formation of join along boundaries bonds between subsystem space-time sheets and the fact that topologically condensed space-time sheets are separated by "elementary particle horizons" from larger space-time sheets, provide the deeper topological motivation for the generalization of subsystem concept.

1.2.6 p-Adic fractality of life and consciousness

p-Adic fractality of biology and consciousness has become an increasingly important guide line in the construction of the theory. This notion allows to relate phenomena occurring in the molecular level to phenomena like remote viewing and psychokinesis and it leads also to the view that topological field quanta of various fields of astrophysical size are crucial for the functioning of biosystems. If one accepts p-adic fractality, the theory can be tested in unexpected manners, in particular in molecular and cellular length scales where the systems are much simpler. Sensory perception, long term memory, remote mental interactions, metabolism: all these phenomena rely on the same basic mechanisms. p-Adic length scale hypothesis allows to quantify the hypothesis with testable quantitative predictions.

1.3 Some basic ideas of TGD inspired theory of consciousness and quantum biology

The following ideas of TGD inspired theory of consciousness and of quantum biology are the most relevant ones for what will follow.

a) "Everything is conscious and consciousness can be only lost" is the briefest manner to summarize TGD inspired theory of consciousness. Quantum jump as moment of consciousness and the notion of self are key concepts of the theory. Self is a system able to avoid bound state entanglement with environment and can be formally seen as an ensemble of quantum jumps. The contents of consciousness of self are defined by the averaged increments of quantum numbers and zero modes (sensory and geometric qualia). Moments of consciousness can be said to be the counterparts of elementary particles and selves the counterparts of many-particle states, both bound and free. The selves formed by macrotemporal quantum coherence are in turn the counterparts of atoms, molecules and larger structures. Macrotemporal quantum coherence effectively binds a sequence of quantum jumps to a single quantum jump as far as conscious experience is considered. The idea that conscious experience is about changes amplified to macroscopic quantum phase transitions, is the key philosophical guideline in the construction of various models, such as the model of qualia, the

capacitor model of sensory receptor, the model of cognitive representations, and declarative memories.

b) Macrotemporal quantum coherence is second consequence of the spin glass degeneracy [D4]. It is essentially due to the formation of bound states and has as a topological correlate the formation of join along boundaries bonds connecting the boundaries of the component systems. During macrotemporal coherence quantum jumps integrate effectively to single long-lasting quantum jump and one can say that system is in a state of oneness, eternal now, outside time. Macrotemporal quantum coherence makes possible stable non-entropic mental images. Negative energy MEs are one particular mechanism making possible macrotemporal quantum coherence via the formation of bound states, and remote metabolism and sharing of mental images are other facets of this mechanism.

c) p-Adic physics as physics of intentionality and cognition is a further key idea of TGD inspired theory of consciousness. p-Adic space-time sheets as correlates for intentions and p-adic-to-real transformations of them as correlates for the transformation of intentions to actions allow deeper understanding of also psychological time as a front of p-adic-to-real transition propagating to the direction of the geometric future. Negative energy MEs are absolutely essential for the understanding of how precisely targeted intentionality is realized.

2 Many-sheeted space-time, magnetic flux quanta, electrets and MEs

TGD inspired theory of consciousness and of living matter relies on space-time sheets carrying ordinary matter, topological light rays (massless extremals, MEs), and magnetic and electric flux quanta. There are some new results which motivate a separate discussion of them.

2.1 p-Adic length scale hypothesis and the connection between thermal de Broglie wavelength and size of the space-time sheet

Also real space-time sheets are assumed to be characterized by p-adic prime p and assumed to have a size determined by primary p-adic length scale L_p or possibly n-ary p-adic length scale $L_p(n)$. More generally, each space-time dimension could correspond to its own p-adic length scale and even several p-adic primes could be associated with single dimension.

The possibility to assign a p-adic prime to the real space-time sheets is required by the success of the elementary particle mass calculations and various applications of the p-adic length scale hypothesis. Rationals are common to reals and all p-adic number fields. The p-adic-to-real transition transforming

intentions to actions is made possible by a large number of common rational points between p-adic and real space-time surfaces, which supports the view that real space-time sheets obeys effective p-adic topology as an approximate topology in some resolution and below some length scale. p-Adic prime thus characterizes the classical non-determinism of the Kähler action.

Parallel space-time sheets with distance about 10^4 Planck lengths form a hierarchy. Each material object (...atom, molecule, ..., cell,...) corresponds to this kind of space-time sheet. The p-adic primes $p \simeq 2^k$, k prime or power of prime, characterize the size scales of the space-time sheets in the hierarchy. The p-adic length scale $L(k)$ can be expressed in terms of cell membrane thickness as

$$L(k) = 2^{(k-151)/2} \times L(151) , \quad (1)$$

$L(151) \simeq 10$ nm. These are so called primary p-adic length scales but there are also n-ary p-adic length scales related by a scaling of power of \sqrt{p} to the primary p-adic length scale. Quite recent model for photosynthesis [D3] gives additional support for the importance of also n-ary p-adic length scales so that the relevant p-adic length scales would come as half-octaves in a good approximation but prime and power of prime values of k would be especially important.

A simple but very predictive hypothesis motivated by quantum-classical correspondence is that the characteristic temperature scale $T(k)$ for particles of mass M in a thermal equilibrium at the space-time sheet characterized by $L(k)$ is given in terms of the zero point kinetic energy associated with the space-time sheet

$$T(k) = n \times E_0(k) = n \times n_1 \times \frac{\pi^2}{2ML^2(k)} , \quad (2)$$

where n and n_1 are numerical constants not far from unity (for convenience the units $k_B = 1$, $\hbar = 1$, $c = 1$ are used). The thermal de-Broglie thermal wavelength is given by $\lambda_{dB}(k) = \sqrt{2mT(k)}$ and apart from numerical constant predicted to be equal to the p-adic length scale $L(k)$. The zero point kinetic energy refers to the thermal motion of nucleus and in the case of a molecule to the heaviest nucleus associated with the molecule. Thus it also thermal motion would have space-time correlate.

$T(k)$ can be interpreted as a critical temperature at which the p-adic prime characterizing the space-time sheet changes. $T(k)$ decreases very rapidly as a function of the p-adic length scale $L(k)$. This equation relates the p-adic prime of the space-time sheet to T and M of the particles present in the sheets forming a join along boundaries condensate. Of course, the size L of space-time sheet characterized by k can vary in the range $[L(k), L(k_>)]$ and also temperature is

continuous but between $T(k)$ and $T(k_>)$, $T \propto 1/L^2$ is the fractal guess for the dependence of the temperature on the size of the space-time sheet.

This guess predicts that the temperature at, say, magnetic flux tubes of the Earth's magnetic field is extremely low and for the flux tube thicknesses achieved already for small values n of the magnetic fluxes, the temperature is below the scale of cyclotron energies. Thus magnetic flux tubes are predicted to allow macroscopic quantum phases if thermal de Broglie hypothesis is accepted. Note however that the temperature is determined by the lightest particle present, which suggests that electrons, protons and various ions might reside at different magnetic flux tubes. The same conclusion is supported by quantum-classical correspondence suggesting that magnetic flux tube has such a shape that it contains the orbit of the particle in the average magnetic field defined by the magnetic flux tube structure. In magnetohydrodynamics it is often assumed that charged particles freeze to magnetic flux lines: now flux tubes would freeze to particles. Magnetic flux tubes would have typically spiral like shapes if this assumption really makes sense [D10].

At room temperatures the space-time sheets associated with say water dominating in living matter is predicted to correspond to $k = 137$ atomic space-time sheet with size about .8 Angstrom. At high enough temperatures above 1000 K, condensed matter, say the material below Earth's crust, resides at $k = 131$ space-time sheets of size about .1 Angstrom. This does not however exclude the presence of cool $k = 137$ space-time sheets, and the life at these space-time sheets would not burn its fingers. Furthermore, the basic predictions of the general model for spherically symmetric mass distributions (symmetry is not actually essential) is that that the matter concentrates on spherical shells [A1]. This would suggest that also In the case of Earth there is dense crust with $k = 137$ followed by much less dense, almost hollow, region below. Below the crust there are also $k = 131$ hot space-time sheets parallel to the atomic ones.

This has dramatic and counter intuitive implications. For instance, one can imagine lifeforms surviving in Earth's interior, with hot space-time sheets serving as an artificial Sun providing metabolic energy as universal quanta in visible portion of the spectrum liberated when atoms and molecules drop from $k = 131$ to $k = 137$ space-time sheet. Amazingly, the most important frequencies in photosynthesis correspond to the zero point kinetic energies at $k = 131$ space-time sheets [D11])!

2.2 Topological light rays (massless extremals, MEs)

I have described MEs, or "topological light rays", in previous articles of JNLRMI [6] and in [C5, D9], and describe here only very briefly the basic characteristics of MEs and concentrate on new idea about their possible role for consciousness and life.

2.2.1 What MEs are?

MEs can be regarded as topological field quanta of classical radiation fields [C5, D9]. They are typically tubular space-time sheets inside which radiation fields propagate with light velocity in single direction without dispersion. The simplest case corresponds to a straight cylindrical ME but also curved MEs, kind of curved light rays, are possible. The initial values for a given moment of time are arbitrary by lightlikeness. Therefore MEs are ideal for precisely targeted communications. What distinguishes MEs from Maxwellian radiation fields in empty space is that lightlike vacuum 4-current is possible: ordinary Maxwell's equations would state that this current vanishes. Quite generally, purely geometric vacuum charge densities and 3-currents are purely TGD based prediction and could be seen as a classical correlate of the vacuum polarization predicted by quantum field theories.

MEs are fractal structures containing MEs within MEs. The so called scaling law of homeopathy predicts that the high frequency MEs inside low frequency MEs are in a ratio having discrete values [D2]. One can indeed justify this relationship. As ions drop from smaller space-time sheets to magnetic flux tubes, zero point kinetic energy is liberated as high frequency MEs, and the ions dropped to magnetic flux tubes generate cyclotron radiation, and the ratio of the fundamental frequencies is constant not depending on particle mass and being determined solely by p-adic length scale hypothesis. The model for the radiowaves induced by the irradiation of DNA by laser light [8] gives support for this picture [D4]. It has become gradually clear that also Z^0 MEs carrying classical Z^0 fields are important in living matter and the model of nerve pulse relies crucially on Z^0 MEs [D5].

2.2.2 Negative energy MEs

MEs can have either positive or negative energy. The understanding of negative energy MEs has increased considerably. Phase conjugate laser waves [7] are the most plausible standard physics counterparts of negative energy MEs since they can be interpreted as time reversed laser beams and do not possess direct Maxwellian analog. By quantum-classical correspondence one can interpret the frequencies associated with negative energy MEs as energies. One can also assume that the Bose-Einstein condensed photons associated with negative energy MEs and with the coherent light generated by the lightlike vacuum current have negative energies.

For frequencies which are above thermal energy there is no system which could interact with negative energy MEs or absorb negative energy photons. Therefore negative energy MEs and corresponding photons should propagate through matter practically without any interaction. Feinberg has demonstrated that phase conjugate laser beams behave similarly: for instance, one can see through chickens using these laser beams [9]. This means that negative energy

MEs do not respect Faraday cages and thus represent an attractive candidate for the hypothetical Psi field. Note that MEs are not a mere classical correlate for photons, as is clear from the fact that in the case of Z^0 MEs there are no Z^0 photons.

Negative energy MEs have many applications.

a) Negative energy MEs ideal for generating time like entanglement. Since negative energies are involved, this entanglement can be seen as a correlate for the bound state entanglement leading to a macrotemporal quantum coherence. Negative energy MEs make thus possible telepathic sharing of mental images. Negative energy MEs are involved with both sensory perception, long term memory, and motor action.

b) Negative energy MEs are ideal for a precisely targeted realization of intentions. p-Adic ME having a large number of common rational points with negative energy ME is generated and transformed to a real ME in quantum jump. The system receives positive energy and momentum as a recoil effect and the transition is not masked by ordinary spontaneously occurring quantum transitions since the energy of the system increases. One can say that negative energy ME represents the desires communicated to the geometric past and inducing as a reaction the desired action realized as say neuronal activity and generation of positive energy MEs.

c) The generation of negative energy MEs is also in a key role in remote metabolism and MEs serve as quantum credit cards implying an extreme flexibility of the metabolism.

2.2.3 How MEs propagate in matter

MEs can propagate in matter in two different manners: along interior or along boundaries (this is new).

a) The interaction analogous to the ordinary interaction of electromagnetic fields with matter is based on the formation of wormhole contacts between ME and the interior of the material space-time sheet. As a consequence, MEs tend to stuck to the interior of the space-time sheets while interacting with matter. This leads to the lowering of the phase velocity from light velocity. Since the sizes of the wormhole contacts are extremely small, about 10^4 Planck lengths, the effect is usually small. At the quantum level the reduction of the phase velocity could be interpreted in terms of the shifting of the positive energy ME in each quantum jump relative to the background space-time sheet to the direction of the geometric future so that the phase associated with a ME would be observed to change more slowly. For negative energy MEs would be opposite if they shift to the direction of geometric past and apparent superluminal light velocity would result. This mechanism is proposed as an explanation for the observed superluminal light velocities [10] in photon tunneling [B2].

b) MEs can also propagate along boundaries of the material space-time sheets. What can happen that ME joins partially along its boundaries to two

space-time sheets, which can be characterized by different p-adic primes. Particles can flow between space-time sheets and charged particles experience the transversal electric field of ME as an external electric potential forcing the particles to flow in a particular direction (note that all nuclei are complete Z^0 ions). The sizes of the join along boundaries contacts are gigantic as compared to the sizes of wormhole contacts and one expects that the reduction of the phase velocity is dramatic. The quantum mechanism for the reduction is same as in the previous case. EEG phase velocity could be interpreted as a reduced effective phase velocity of Z^0 and em boundary MEs [D5]. One can assign also to boundary MEs dielectric constant allowing to model their interaction with matter.

An open question is whether also negative energy MEs can propagate along boundaries or whether topological considerations related to the notion of time orientations forbid this. For negative energy MEs the propagation along boundaries would predict highly superluminal effective phase velocities.

2.3 Magnetic flux quanta and electrets

Magnetic flux tubes and electrets are extremals of Kähler action dual to each other. Also layer like magnetic flux quanta and their electric counterparts are possible. The magnetic/electric field is in a good approximation of constant magnitude but has varying direction.

2.3.1 Magnetic fields and life

The magnetic field associated with any material system is topologically quantized, and one can speak about magnetic body. An attractive idea is that the relationship of the magnetic body to the material system is to some degree that of the manual to an electronic instrument. Magnetic body would thus allow to realize both sensory and abstract symbolic representations about the material body. Magnetic body would in this case serve as a kind of computer screen at which the data items processes in say brain are communicated either classically (positive energy MEs) or by sharing of mental images (negative energy MEs).

Magnetic body is also an active intentional agent: motor actions are controlled from magnetic body and proceed as cascade like processes from long to short length and time scales as quantum communications of desires at various levels of hierarchy of magnetic bodies. Communication occurs backwards in geometric time by negative energy MEs. Motor action as a response to these desires occurs by classical communications by positive energy MEs and as neural activities. This explains the coherence and synchrony of motor actions difficult to understand in neuroscience framework. The sizes of flux tubes are astrophysical: for instance, EEG frequency of 7.8 Hz corresponds to a wavelength defined by Earth's circumference. The non-locality in the length scale of magnetosphere, and even in length scales up to lightlife, is forced by Uncertainty

Principle alone, if taken seriously in macroscopic length scales. Magnetic

The leakage of supra currents of ions and their Cooper pairs from magnetic flux tubes of the Earth's magnetic field to smaller space-time sheets and their dropping back involving liberation of the zero point kinetic energy defines one particular metabolic "Karma's cycle". The dropping of protons from $k = 137$ atomic space-time sheet involved with the utilization of ATP molecules is only a special instance of the general mechanism involving an entire hierarchy of zero point kinetic energies defining universal metabolic currencies. This leads to the idea that the topologically quantized magnetic field of Earth defines the analog of central nervous system and blood circulation present already during the prebiotic evolution and making possible primitive metabolism. This has far reaching implications for the understanding of how prebiotic evolution led to living matter as we understand it [D11].

For instance, it has recently become clear that the dropping of atoms and molecules from $k = 131$ space-time sheets creates photons at visible and near infrared wavelengths. The hot $k = 131$ space-time sheets (with temperatures above 1000 K) could have served as a source of metabolic energy for lifeforms at cool $k = 137$ sheets. Photosynthesis could have developed in the circumstances where solar radiation was replaced with these photons. The correct prediction is that chlorophylls should be especially sensitive to these wavelengths. In particular, it is predicted that also IR wavelengths 700-1000 nm should have been utilized. There indeed are bacteria using only this portion of solar radiation. This leads to a scenario making sense only in TGD universe. Prebiotic life could have developed at the cool space-time sheets in the hot interior of Earth below crust, where $k = 131$ space-time sheets are possible and this life could still be there [D11]. Also the life as we know it, could involve hot spots generated by the cavitation of water inside cell. The classical repulsive Z^0 force causes a strong acceleration during final stages of bubble collapse creating high temperatures, and could explain also sonoluminescence [11] as suggested in [B1].

Magnetic Mother Gaia could also form sensory and other representations receiving input from several brains via negative energy EEG MEs entangling magnetosphere with brains. The multibrained magnetospheric selves could be responsible for the third person aspect of consciousness and for the evolution of social structures. Some aspects of remote viewing very difficult to understand if remote viewing involves only the target and viewer [12], the successful healing by prayer and meditation groups [13], and the experiments of Mark Germaine [14] support the view that multibrained possibly magnetospheric selves are involved. Magnetic flux tubes could function as wave guides for MEs and this aspect is crucial in the model of long term memory.

2.3.2 Electrets and biosystems

Biosystems are known to be full of electrets and liquid crystals [15]. Perhaps the most fundamental electret structure is cell membrane. In particular, the

water inside cells tends to be in gel phase which is liquid crystal phase. There are many good reasons for why water should be in ordered phase. One very fundamental reason is that biopolymers are stable in liquid crystal/ordered water phase since there are no free water molecules available for the depolymerization by hydration. In fact, only a couple of years ago it was experimentally discovered that biopolymers can be stabilized around ice.

The capacitor model for sensory receptor is one very important application of the electret concept (see the article "Quantum model of sensory receptor" in this issue of JNLRMI and [D7]). Sensory qualia result in the flow of particles with given quantum numbers from the plate to another one in quantum discharge. This kind of amplification of quantum number *resp.* zero mode increments would give rise to both geometric *resp.* non-geometric qualia [D7].

Also microtubuli are electrets. Sol-gel transition, as any phase transition, is an good candidate for the representation of a conscious bit and controlled local sol-gel transitions between ordinary and liquid crystal water could be a basic control tool making possible cellular locomotion, changes of protein conformations, etc... The tubulin dimers of microtubuli could induce sol-gel transformations by generating negative energy MEs, and microtubular surface could provide bit maps of their environment somewhat like sensory areas of brain provide maps of body. If gel→sol transition around tubulin inducing conformational change induces sol→gel transformation in some point of environment as would be the case for the seesaw mechanism to be discussed below, a one-one correspondence would result. By this one-one correspondence microtubules would automatically generate kind of conscious log files about the control activities which could have evolved to microtubular declarative memory representations about what happens inside cell [D3].

3 Some applications of the many-sheeted space-time concept

In this section some applications of the many-sheeted space-time concept are represented in the hope that they might give idea about how the basic concepts and rules can be applied in practice.

3.1 A general model for energy storage and energy utilization by remote metabolism

The general model for energy storage and utilization based on remote metabolism is surprisingly simple [D3].

a) Metabolic energy can be stored as a zero point kinetic energy to various space-time sheets. Typically there are two space-time sheets involved: the larger space-time sheet characterized by p-adic prime k_{gr} defines the ground state of

the many-sheeted laser and the smaller space-time sheet characterized by k_{ex} defines the excited state serving as the energy storage. At least the particles at $k = k_{gr}$ space-time sheet form Bose-Einstein condensate. The energy storage involves the kicking of particles to $k = k_{ex}$ space-time sheet and is analogous to a population inversion in laser. Bose-Einstein condensates of electronic Cooper pairs, H atoms, H₂ atoms and protonic Cooper pairs, O and O₂ atoms,... are possible. The dropping of a particle to a larger space-time sheet liberates a standardized energy quantum. Since Bose-Einstein condensate is in question, this process can occur coherently which allows high metabolic power. The power is especially high if both space-time sheets carry Bose-Einstein condensates.

b) Remote metabolism provides an elegant manner to utilize the stored energy. The user must only send negative energy ME at energy sufficiently near to the energy currency. This implies a highly economical use of the metabolic energy. For instance, when an enzyme needs energy, it generates negative energy ME activating ADP to ATP by kicking proton to the atomic $k = 137$ space-time sheet. In this case .5 eV plus possibly an additional energy .34 eV to kick phosphate ion to $k = 131$ space-time sheet is needed [D3]. In the case of population inversion negative energy MEs could serve only as a seed of phase transition in which a population inverted laser returns to the ground state (the rate for the transition to the ground state is proportional to the particles in the ground state). Negative energy photons even at the intensities of biophotons might be enough to induce remote metabolism. It is known that the light generated by mitochondria is not only due to the ordinary metabolism [16]: remote metabolism might be in question.

c) "Seesaw" mechanism minimizes the waste of metabolic energy since the same energy can be used repeatedly [D3]. In the simplest situation two users send alternately negative energy MEs to each other so that dissipative losses are minimized. Negative energy MEs and seesaw mechanism are not restricted to transitions involving the dropping of particles between space-time sheets: any transitions will do but it would seem that Bose-Einstein condensates must be in question. For instance, the model applies also to cyclotron transitions.

d) The fact that proton mass is with 6 percent accuracy 2^{11} times the mass of electron implies approximate symmetry. Proton or hydrogen atom at space-time sheets k corresponds to electronic Cooper pair at space-time sheet $k + 10$ as far as zero point kinetic energies are considered so that one has an approximate $(proton, k) \rightarrow (2e, k + 10)$ symmetry. This means that the protonic and electronic energy currencies are consistent with each other. Concerning the construction of the models, this implies certain degree of non-uniqueness.

3.2 Capacitor model of sensory qualia

The assumption that sensory qualia are realized at the level of sensory receptors, when combined with the requirement that the average increments are non-vanishing, and perhaps even same from quantum jump to quantum jump and

amplified to a quantum phase transition, poses strong constraints on the model of the sensory receptor. The detailed model is discussed in the article "Quantum model for sensory receptor" in this issue of JNLRMI and in [D7].

These constraints motivate what might be called the capacitor model of the sensory receptor.

a) There are two reservoirs of quantum charges having total charges of equal magnitude but of opposite sign (quantum charges refer to any quantum numbers, not only electric charge). The net charges are macroscopic in order to guarantee robustness. These reservoirs are analogous to capacitor plates, and only the second one corresponds to the sensory experienced quale unless both the quale and its conjugate are experienced simultaneously. Capacitor plates can carry several charges simultaneously.

b) When the sensory quale is generated, there is a flow of charge quanta between the quantum capacitor plates. The charge quanta are more or less constant. This requirement could be relaxed to the condition that only the average increment is constant.

Cell membrane, or rather the pair formed by cell interior and exterior, and synaptic junction are excellent candidates for quantum capacitors.

a) During nerve pulse various ions flow between cell interior and exterior, which suggests that sub-neuronal sensory qualia are generated in a time scale of millisecond. Also membrane oscillations might give rise to some kind of sensory qualia. In particular, superconducting Cooper pairs and bosonic ions enter or leave the Bose-Einstein condensates at the magnetic flux tubes and this should give rise to a chemical experience defined by the quantum numbers of the carrier particle. Not only the increment of electric charge but increments of magnetic quantum numbers characterize the qualia in question. Various information molecules transferred through the cell membrane could also give rise to sensory qualia.

b) In the synaptic contact the vesicles containing neurotransmitter are transmitted, and the net quantum numbers for the vesicles should determine the neuronal chemical qualia associated with the process.

c) One realization of the capacitor plates as parallel space-time sheets with different values of p-adic prime. Also now there could be electric or Z^0 electric potential difference between space-time sheets along join along boundaries bonds. A population reversed many-sheeted laser might perhaps describe what is involved. The generation of population reversal for Bose-Einstein condensed bosons followed by the dropping of the bosons to the larger space-time sheet would correspond to a generation of quale. Quale and its conjugate quale could correspond to generation of population reversal and its decay. Population reversal would also provide a storage of metabolic energy and remote metabolism sending negative energy MEs to the system inducing dropping of bosons to a larger space-time sheet would thus perhaps induce a sensory quale. Photosynthesis and $ADP \rightarrow ATP$ transformation would be typical examples about this kind of remote metabolism involving "metabolic" qualia.

Capacitor model does not apply to all qualia. Qualia might be also associated with the quantum phase transitions at magnetic flux quanta. A typical example is a coherently occurring cyclotron transition for a macroscopic phase of Cooper pairs. It would seem that quantum phase transitions at the magnetic flux quanta and particle flows between the quantum electrodes associated with electret type structures could define two basic types of qualia. Note that electret structures are dual to magnetic flux quanta as solutions of field equations. Vision and hearing would be basic examples of these two types of qualia.

3.3 Support for the notion of remote metabolism

The list of applications of negative energy MEs is now quite long. Below some examples providing support for the notion of remote metabolism are discussed.

3.3.1 Remote metabolism, photosynthesis, and ionic pumps

Photosynthesis is a fundamental metabolic function and a many-sheeted model allows to concretize the general ideas about quantum metabolism. What happens in photosynthesis at the level of energy balance seems to be relatively well-understood [17, 18] but the detailed molecular mechanisms remain obscure. Several strange features, such as the appearance of electron pairs, suggest that superconductivity and atomic and molecular Bose-Einstein condensates are involved.

p-Adic length scale hypothesis gives stringent quantitative guidelines in the attempt to understand photosynthesis in many-sheeted space-time, and one ends up to a general view about how Bose-Einstein condensates store metabolic energy as zero point kinetic energy and how this energy is utilized by remote metabolism by generating negative energy MEs sent to population inverted many-sheeted lasers. Electronic Cooper pairs kicked to $k_{ex} = 155$ space-time sheet from $k_{gr} = 149$ lipid layer of cell membrane space-time sheets are involved with the photosystem II. Electrons kicked to $k_{ex} = 157$ space-time sheet from $k_{gr} = 151$ cell membrane space-time sheets are involved with photosystem I. The resulting simple model of photosynthesis is successful both at qualitative and quantitative level. In particular, the energy 1 eV/electron for the excitations of the reaction center is predicted correctly from p-adic length scale hypothesis. The model also explains why the electrons from photosystem II producing oxygen from water and generating ATP molecules end up to the photosystem I [D3].

Similar picture applies to the ionic pumps whose efficiency seems somewhat mysterious [19]. First of all, ionic pumps are needed only if join along boundaries bonds connecting the cell interior with exterior are present (say during nerve pulse). This means a dramatic reduction in metabolic costs. Ionic pumps also send negative energy MEs to population inverted many-sheeted lasers acting as molecular bank automatons providing the energy needed to go to the other

side of the cell membrane. In the case of Ca_{++} cell membrane resting potential corresponds to a potential energy near to a zero point kinetic energy .125 eV for hydrogen atoms or protons at $k = 139$ space-time sheet or electronic Cooper pairs at $k = 149$ space-time sheet with accuracy better than 3 per cent. .065 eV energy corresponds to the zero point kinetic energy of protonic Cooper pairs or H_2 molecules at $k = 139$ or of electrons at $k = 151$ space-time sheet.

3.3.2 Memory feats of synesthetes

Synesthesia involve also exceptional episodal memory feats with simultaneous lowering of metabolic rate in left brain with as much as 18 per cent [20] (for TGD inspired model of synesthesia see [C3]). This should be lethal according to the standard wisdom. The simplest explanation is that the starving neurons in the left cortex generate negative energy MEs which entangle left brain with the geometric past. This allows left cortex to get energy from the brain of the geometric past and as a by-product induces episodal memories.

The explanation of various findings of Libet about the time delays of sensory consciousness discussed in the article "Time, space-time, and consciousness" in this issue of JNLRMI suggests a more complex model. Starving neurons draw energy from sensory organs so that the magnetic body, usually drawing energy from the sensory organs, is forced to draw energy from the geometric past. Thus sensory experience with an input coming from the geometric past results, and could give rise to episodal long term memories. This model applies also to the experiences generated by an artificial electric or magnetic stimulation of neurons. Also the life review of NDE experiences could be a by-product of neuronal starvation. Philosophizing a little bit, one might perhaps see the purpose of suffering as generating bound state entanglement and thus making possible the macroscopic and macrotemporal quantum coherence.

3.3.3 Insect-plant communications

Callahan has made very important discoveries related to the olfaction of insects and insect-plant interaction. Callahan's work [21, 22] demonstrates that the insect olfaction is based on infrared light generated by the odorant molecules interacting with the antennae of the insects. Also the olfaction of higher organisms could rely on IR light generated by odourant molecules. Callahan has also shown plants communicate with insects utilizing infrared light [22]. This conforms with the findings of Albrecht-Buehler [23] showing that all cells contain microtubular structures acting as receiving antennae for infrared light. Furthermore, plants suffering from de-nutrition are found more easily by insects than healthy plants.

These findings encourage to consider the following mechanism for insect-plant communications. This mechanism could apply also to the plant-human interactions [D1].

a) Insects generate infrared MEs propagating like massless particles inside low frequency negative energy MEs acting as bridges quantum entangling the plant and the insect. Both classical communications by positive energy IR MEs and quantum communications by negative energy IR MEs are in principle possible.

b) In the case that plant suffers from denutrition, it can gain metabolic energy by sending negative energy MEs received by insect. This gives for plant metabolic energy and at the same time generates the quantum entanglement bridge making it possible for the insect to find the plant.

3.3.4 Dogs and their masters

Dogs are also claimed to be able to anticipate that their masters are arriving home. Some dogs are able to anticipate the epileptic attacks of their master. The highly developed sense of smell of dogs is usually represented as an explanation of this ability. This might be a correct conclusion but in different sense as usually believed. If IR MEs represent a crucial element of olfaction, one can consider the possibility that dog precognizes its master's epileptic attack by receiving the negative energy MEs generated by the starving neurons in the master's brain in the geometric future. This explanation requires that epileptic attacks occur in the master's brain also in the geometric future where intentions are not yet realized. Similar mechanism might be involved with the ability to anticipate the arrival of the master to home. It is possible to test this hypothesis: are dogs more able to precognize the activities of their master if master is tired or sick.

The proposed model is also consistent with the hypothesis that olfaction corresponds to a "skin sense" in the sense that the backprojection from brain is based on classical communications and sensory organs entangle with external world. The hypothesis is motivated by the observations about the development of embryo [D7] and is discussed in the article "Quantum model of sensory receptor" in this issue of JNLRMI.

4 Time and intentionality

The highly non-trivial question is how psychological time emerges in TGD framework, where moments of consciousness correspond to quantum jump between quantum histories (histories in the sense that configuration space spinor fields have space-time surfaces as classical correlates). I have proposed two mechanisms to achieve this. In both cases the time-asymmetry of the future lightcone is the fundamental inducer of the arrow of psychological time.

a) Space-time sheets having finite geometrotemporal duration drift to the direction of the geometric future. The direction of drifting is forced by the breaking of time reflection symmetry implied by the geometry of the future lightcone. This option will not be discussed in this article.

b) Psychological time defines the front of p-adic-to-real phase transition

transformation intentions to actions. This option seems to be more plausible. It does not however exclude the possibility that also mindlike space-time sheets indeed drift to the direction of geometric future.

There are also other questions about time and intentionality.

- a) How consensus time emerges and is there a universal time in some sense?
- b) Are there also doers besides the deeds? That is: are there also causal agents and how they could be defined;
- c) Can one distinguish between quantum randomness and the non-determinism of intentionality? Is it possible to measure whether the system is intentional?

4.1 Psychological time and intentionality

In materialist's world one might have experience of free will but non-determinism would be replaced with non-computability or something akin to that. In theories of quantum consciousness based on standard QM one has only state function collapse and it is difficult to understand where the intentionality comes from and how quantum non-determinism differs from randomness. In TGD framework one has both the experience of free will and genuine non-determinism. p-Adicity and the new view about space-time allow precisely targeted intentionality, and one can characterize the long range temporal correlations and the failure of the statistics based on real topology as signatures of intentionality.

The basic vision is that volitional act is realized as a phase transition of a p-adic space-time sheet to a real space-time sheet. These phase transitions are 4-dimensional and induced in quantum jumps. The propagation of phase transition front to the direction of future defines the flow of the psychological time.

4.1.1 What causality means in TGD framework?

In order to minimize confusion it is in order to clarify the various meanings that one can give to causality in TGD framework.

a) At the level of space-time surfaces the absolute minimization of Kähler action defines dynamics of the space-time surfaces and defines the causality of passive events at classical level. Induced spinors (spinors of the 8-D imbedding space restricted to the space-time surface) obey the supersymmetric variant of field equations for the space-time surface and single particle Schrödinger equation can be identified as the non-relativistic limit for the dynamics of the induced spinor fields. The finite size of the space-time sheet defines naturally the notions of coherence length and time for both classical fields and spinor fields. In both cases classical determinism is broken in its naive form. For p-adic space-time sheets p-adic variants of field equations hold true and have the inherent p-adic non-determinism.

b) At configuration space level general coordinate invariance together with huge superconformal invariance related symmetries can be said to dictate the

behaviour configuration space spinor fields playing a role analogous to quantum states of quantum field theories. If the naive classical determinism of Kähler were not broken, the physics would reduce to the boundary of the future light-cone, the moment of big bang and time would be lost as in the canonical quantization of General Relativity. Fortunately this does not happen.

c) Quantum jumps can be said to realize the causality with respect to the subjective time, the causality of deeds. Selves can be seen as self-organization patterns acting as causal agents. At this level system's behaviour is based on rules analogous to those governing the behaviour of statistical cellular automata and are a result of self-organization. The laws are not absolute but analogous to traffic rules obeyed or possibly disobeyed by intentional agents.

A further question concerns causal agents: everyday thinking suggests that deeds indeed have doers. In quantum consciousness theories based on standard quantum measurement theory doers are "observers" somewhere outside. In TGD causal agents are rather abstract: ensembles of quantum jumps deciding to some degree what kind of quantum jump they want to add to the ensemble defining them.

4.1.2 Materialization of intentions

Em fields, in particular ELF em fields, are crucial for the TGD inspired model of brain and a natural assumption is that p-adic-real phase transitions occur also for massless extremals (MEs). A concrete picture about the materialization of intentions emerges, when one asks how a precisely targeted intention could be realized at the atomic or molecular level. The basic point is that molecules can only intend to make simple quantum transitions.

a) If the transition occurs to a lower energy state it can occur spontaneously whereas the transitions to a higher energy states cannot. Spontaneous transitions mask the possibly occurring intended transitions so that only the transitions which cannot occur spontaneously allow precisely targeted intention.

b) What would happen is that first a p-adic ME representing the intention to perform the transition is generated. Then the transition occurs and conservation laws require that the p-adic ME is transformed to a negative energy ME in the transition. Physical intuition suggests that the p-adic ME and the corresponding real ME resemble each other maximally in the sense that they go through the same rational imbedding space points in some p-adic resolution and with respect to the p-adic topology which is effective topology in the case of the real ME.

c) Quite generally, it seems that intention can be realized in a precisely targeted manner only for the transitions which cannot occur spontaneously, and thus involve the emission of negative energy MEs.

d) The generation of negative energy MEs utilizes the buy now-let others pay mechanism of metabolism, which implies extreme flexibility. Of course, there must exist an unselfish self, which is able to pay and this puts severe constraints on the mechanism.

4.1.3 Psychological time as a front of volition identified as p-adic-to-real phase transition

A natural resolution of the problems related to the preferred role of single moment of time for conscious experience is based on the idea that biological growth and self-organization is a phase transition front proceeding in the direction of the geometric future quantum jump by quantum jump. And, in particular, that the dominating contribution to the conscious experience comes from the front of the phase transition where the volition is realized. The phase transition in question would be nothing but transformation of intentions to action and thus p-adic-to-real phase transition proceeding quantum jump by quantum jump towards geometric future.

It seems that our geometric past is relatively stable and that quantum transitions affecting geometric future in long time scales occur rarely. If this were not the case, miraculous events would occur. Physicist would transform in single quantum jump to a musician when the young student in the geometric past of subjective now would change his future plans. There are however anecdotal reports about miraculous healings in which the entire physical appearance of the person suddenly changes so that one must be cautious here. Certainly our long term memories, which in TGD framework are interpreted as mental images of the geometric past shared by quantum entanglement with geometric now, are unstable. This means that the geometric past is probably unstable in sufficiently short length and time scales. Hence it seems reasonable to assume that geometric past does not involve intentional action in length/time scales much longer than neuronal length/time scale responsible for mental images.

One of course ask what is the time scale in which geometric past p-adicizes in long time scales and our four-dimensional body can be lived again. It is quite conceivable that there is this kind of refractory period. Certainly this period must be longer than the time scale in which the intentions affect the geometric future. One fascinating question is what in the geometric future is p-adic: are only MEs p-adic?; are p-adic magnetic flux tubes there?; could the developing organism have a rough p-adic body plan; could cognitive mental images be represented in terms of p-adic neutrino-antineutrino pairs? Be as it may, the conservation of energy and various other quantum numbers forces to conclude that the material world exists also in the geometric future and the question is how wide is the range of intentional action. A good guess is that intentional action selects between the almost degenerate absolute minima of Kähler action implied by the spin glass degeneracy and thus having same induced Kähler field.

A natural guess for the average increment of the geometric time in quantum jump is as CP_2 time so that there would be about 10^{39} quantum jumps per second. This assumption is motivated by the quantum jump as the elementary particle of consciousness metaphor and by the fact that CP_2 time represents naturally a fundamental unit of time. If the rate of increase for psychological time could be different for selves able to communicate and observe each other,

rather counter intuitive conclusions would follow.

Note that macrotemporal quantum coherence effectively increases the duration of the quantum jump to the duration of the bound state responsible for the coherence. During these experiences ordinary categories of time and space do not apply. These experiences can be also interpreted as experiences about what it is to be in quantum superposition. Sensory qualia like colors seem to correspond to this kind of mental images having no reduction to the level of classical space-time dynamics.

4.1.4 How consensus geometric time emerges?

The assumption that the dominating contributions to the contents of our everyday consciousness correspond to roughly same value of time seems to be an intuitively obvious fact. In TGD framework this assumption translates to the hypothesis that there is collective higher level self having us as subselves and that there is a phase transition front in which intentions represented by p-adic space-time sheets transform to real space-time sheets representing actions.

To get convinced that this assumption is necessary, one can imagine a situation in which the intention-to-action phase transition occurs at different values of geometric time so that Bob would be transforming his intentions to actions in the geometric future of Alice or vice versa. If Bob would live in the geometric future of Alice, Alice would see Bob's geometric past. Bob would behave like an almost robot like entity without expressing intentions and free will. If Bob would live in the geometric past of Alice, then Alice would experience Bob's behaviour as utterly unpredictable.

The presence of collective levels of consciousness in astrophysical length scale is thus necessary for a consensus time. This requires macrotemporal quantum coherence in astrophysical length scales made possible by the spin glass degeneracy of TGD universe. Bound state formation in astrophysical length scales is crucial for this coherence and gravitational interaction becomes a key player here although TGD suggests strongly that also classical Z^0 forces are important: in fact, classical em and Z^0 fields are unavoidably accompanied by gravitational fields. For instance, negative energy MEs inducing timelike entanglement carry both classical gravitational and em/ Z^0 fields so that it is a matter of taste whether one speaks about gravitational/em or Z^0 MEs.

It is interesting to notice that there is a close connection with the basic difficulty of quantum field theories. In QFT framework it has not been really possible to appropriately describe bound states. Even the model of hydrogen atom based on Bethe-Salpeter equation has dramatic failures whereas non-relativistic models work very satisfactorily [25]. The basic difference between relativistic and non-relativistic treatments is that non-relativistic treatment assumes common time for particles forming the bound state. In Poincare invariant quantum field theory this kind of assumption cannot be made so that each particle has its own time. In TGD framework particles are 3-surfaces and bound states of

them involve the generation of join along boundaries bonds so that the common time emerges automatically. This does not break Poincare invariance since it is realized in the 8-dimensional imbedding space rather than at space-time surfaces.

The subjective and geometric times are universal in a well-defined sense whereas the correspondence between subjective and geometric time depends on which corner of 4-dimensional space-time surface the self lives. Subjective time is universal by definition since quantum jumps are performed by the entire universe. Macrotemporal quantum coherence leads to the integration of a large number of quantum jumps to single effective quantum jump, whose duration serves as a unit of subjective time. p-Adic time scales are highly suggestive as universal chronons. There is an infinite number of manners of selecting a geometric time coordinate for space-time surface but under rather general conditions one can use the lightcone proper time defining cosmic time as a unique universal geometric time coordinate. In general relativity this kind of universal time does not exist.

4.2 Why p-adic intentionality does not reduce to quantum randomness?

The basic argument against quantal free will is that quantum non-determinism is basically randomness of a particular kind so that one can apply statistical determinism to predict the behaviour for an ensemble of systems. The crucial question is whether also p-adic intentionality reduces to randomness so that statistical determinism applies. One can imagine two mutually consistent approaches to the problem.

a) The notion of randomness is based on the notion of probability, and it could happen that the notion of probability simply does not make sense at all for a system exhibiting an intentional behaviour or that the probabilities do not exist in the real sense but only as p-adic probabilities. Thus abnormal statistics might serve as a signature of an intentional system.

b) Intentionality involves free will and unpredictability in short time scales but predictability in long time scales. This could serve as a signature of an intentional system. Quantum-classical correspondence states that the dynamics of space-time surface mimicks quantum dynamics and therefore also the dynamics of consciousness and intentionality. If so the behavioural patterns of an intentional system characterized by p-adic prime p should obey p-adic topology, which is a strong and testable prediction.

4.2.1 p-Adic topology for time series as a signature of intentionality

Intentional behaviour means that there is unpredictability in short time scales but predictability in long time scales because system can realize its long term

plans and use its partially free will to cope with the changing challenges of the everyday life.

p-Adic topology could realize this idea.

a) The rational values of real and p-adic imbedding space coordinates correspond to the same points of the generalized imbedding space (essentially union of real and p-adic imbedding spaces for various values of p with common rational points identified).

b) The points, which are p-adically close to each other can have arbitrarily long real distance since the points x and $x + kp^n$, $k \in \{0, p-1\}$, become arbitrarily near to each other p-adically and arbitrarily far way in real sense as n increases for the p-adic topology characterized by prime p .

Thus p-adic long range fractal correlations could simply result from p-adic continuity. The local unpredictability would be mimicked by a discontinuous behaviour in the real topology resulting from the fact that time values close to each other in the real sense are far from each other in p-adic sense.

p-Adic non-determinism means that integration constants of p-adic differential equations having by definition vanishing derivatives, are functions of the binary cutoffs x_N defined as $x = \sum_k x_k p^k \rightarrow x_N = \sum_{k < N} x_k p^k$ of the arguments of the function. Since the rational values of real and p-adic coordinates correspond to same points of imbedding space, this means that p-adic non-determinism realizes intentionality by fixing the solution of field equations at a finite number of points below some real time (length) scale defined by N . The choice of these pseudo constants would characterize p-adic intentionality, the future plan of the system relatively stable against quantum jumps and the range of intentional action would be finite, which could explain why the young person in the geometry youth now cannot make choices affecting dramatically the geometric now decades later.

There is an analogous non-determinism also in the real sector due to the dramatic failure of the complete non-determinism of the basic action principle determining the dynamics of space-time surfaces. This non-determinism makes it possible to transform intentions to actions by p-adic-to-real transitions occurring in quantum jumps. It also justifies the characterization of the real space-time sheets by a p-adic primes.

Consider now a situation in which some observables of might-be intentional system are measured as a function of time. Suppose that measurement are carried out at moments $t_n = n\Delta T$, $\Delta T = T/N_m$, where T is the duration of the experiment and N_m is the number of measurements.

a) With respect to the real topology the behaviour of the system would look random in short time scales with violent discontinuities independently how precise the time resolution is made: fluctuations would actually become more violent with the improving time resolution.

b) p-Adic fractality would predict long range correlations over arbitrarily long time scales p^n in this kind of situation. Time values t and $t + rp^k \Delta T$ would be near to each other p-adically so that the values of the observables

measured at these time values would be near to each other. Long range temporal correlations would thus quantify the ideas that will is not completely free and that intentionality implies an approximate predictability in long time scales. The fact that p-adic pseudoconstants allow intentional free will only below some time and length scales, justifies the idea that our life is in long time scales determined by what might be called fate although we can make freely decisions in short time scales. The stability of the p-adic pseudo constants and binary cutoff N in quantum jumps would also mean that the realization of p-adic intentions occurring subjectively now in my geometric childhood would not have dramatic implications in the geometric now.

c) p-Adic fractality would also mean that similar behavioral time patterns could repeat themselves as temporally scaled-up versions. Person would react in a similar manner in different time scales, say in stressing situation lasting for few minutes or many years. What is used to call as personality might have something to do with these fractal behavioural patterns. There is indeed statistical evidence for the possibility to predict much about the life cycle of a person from the behavioural patterns in childhood. The child who wants all now tends to become an adult who does the same. Some aspects of personality would perhaps represent something not invariant under time translations but under p-adic time scalings.

4.2.2 How statistical behaviour could exhibit intentionality?

Consider an ensemble of consisting of N_m measurements of some observables of a system during a fixed time interval T occurring at equally spaced moments of time $t_n = n \times \Delta T$, $\Delta T = T/N_m$. Classify the measurements by some equivalence relation so that there are I possible outcomes and estimate the probabilities for the outcomes as rational numbers $p_i = n_i/N_m$, $\sum n_i = N_m$. When N_m becomes large one should obtain estimates for the probabilities of various instances labelled by $i = 1, \dots, I$. The standard frequency interpretation of probability theory relies on the assumption is that these estimates converge in real topology so that the estimates $p(i, N_m + k) = n_i/N_m + k$, $k \ll N_m$ and $p(i, N_m) = n_i/N_m$ do not differ much for large values of N_m .

It is however quite possible that $p(N_m)$ converges in some p-adic topology which would mean that in the real topology the estimates would fluctuate wildly without any convergence, in a typically fractal manner. The estimates for probabilities would however converge p-adically in which case the system would be intentional and characterized by some p-adic prime p . The quantum-classical correspondence suggests that the sequence of N_m measurements performed for an intentional system during time interval T can be modelled as a sequence of measurements performed for a p-adic space-time sheet serving as its correlate. With this assumption one can immediately conclude that the estimates for the probabilities do not converge since various observables are continuous functions with respect to p-adic rather than real topology and ΔT does not approach zero

at the limit $N_m \rightarrow \infty$ but fluctuates wildly. Only for N_m and $N_m + kp^n$ p-adic continuity guarantees that probabilities estimated in this manner are near each other.

It must be emphasized that the notion of p-adic probability based on frequency interpretation satisfies the Kolmogorov axioms as demonstrated by Khrennikov [26]. The notion of resolution $\Delta T = T/N_m$ defining what $N_m \rightarrow \infty$ limit really means is an absolutely essential additional element. If one defines $N_m \rightarrow N_m + 1$ as an addition of one additional measurement to existing sequence of measurements, the frequencies convergence to ordinary real probabilities with a given resolution since only one of the numbers n_i changes in $N_m \rightarrow N_m + 1$. The notion of resolution makes sense also in spatial degrees of freedom.

The notion of resolution is unavoidable already in quantum field theories in order to reduce degrees of freedom which are not directly experimentally detectable since the that measurement resolution is always finite. The notion of renormalization group realizes mathematically the notion of finite resolution [27]. Thus resolution dependent statistics is not anything new. What is new is p-adicity and the long range correlations reducing to the p-adic continuity because of different concept of nearness. Note also that p-adically small structures have real sizes which are astrophysical so that cognition and intentionality are naturally astrophysical phenomena in accordance with the notions of magnetic body and ME.

These considerations suggests how one could try to demonstrate p-adic intentionality experimentally.

a) One might hope of demonstrating that intentional systems behave apparently randomly in short time scales but that there are long range temporal correlations in time scales $t_n = p^n \Delta T$, $\Delta T = T/N_m$. Wild fluctuation of the probability estimates as function of N_m is a direct signature of intentionality. The approximate invariance of the frequencies under the transformations $N_m \rightarrow N_m + p^n \Delta T$ in turn allow to identify the value p . This approach could be used to prove the presence of the p-adic intentionality even at the molecular level or at level of say solar and planetary magnetospheres by studying the temporal behaviour of the fluctuations of magnetic fields. For instance, it is known that solar magnetic field has what might be called memory [28], which should not be there if it were really random. For tornadoes the presence of short range chaos and long range order in at least spatial degrees of freedom is obvious. Period doubling in the systems approaching chaos could be a signature for the appearance of 2-adic intentionality in increasingly longer time scales. Also $1/f$ noise, not really understood in standard physics framework, might be related to intentionality.

b) One could also test the number theoretic information measures suggested by the p-adic approach using preferred resolutions defined by $N_m = kp^n$. Number theoretic information measures make sense for rational valued probabilities, and are obtained from Shannon entropy by replacing ordinary logarithm with the p-adic logarithm $Log_p(x) = \log(|x|_p) = \log(p^k) = k \log(p)$ to get

$S_p = -\sum_n p_n \text{Log}_p(p_n)$. The number theoretic entropies can have also negative values in which case one can say that the ensemble contains genuine information.

4.2.3 How the p-adic primes involved with intentionality and ordinary physics are related?

In real physics the p-adic primes involved are very large, for instance, $p = 2^{127} - 1$ for electron. These large primes however labels real space-time sheets and characterize their fractality and *effective* p-adic topology. p-Adic length scale hypothesis in its basic form predicts that primary and n-ary length/time scales correspond to powers of $\sqrt{2}$ of the fundamental p-adic length/time scales so that 2-adic fractality would indeed be realized in this sense. Besides the basic units for time and length also their integer multiples can take the role of the basic unit, this of course in accordance with the very notion of fractality.

Small primes would characterize p-adic space-time sheets serving as correlates of intentions. It seems that only relatively small values p , $p = 2$ being the simplest guess, are realized as far as intentionality is considered. The octaves in music realize 2-adic fractality and it might not be an accident that binary mathematics is mathematics of computation.

4.3 Some paradoxes solved by the new view about time

In the sequel some paradoxes of modern physics and philosophy of mind related closely to the notion of time, are discussed.

4.3.1 Paradoxes related to quantum physics

The basic paradox is the conflict between the non-determinism of the state function reduction and the determinism of the Schrödinger equation. At a more general level this paradox is the conflict between the subjectively experienced actuality of the free will and the determinism of the objective world. The resolution of this paradox in TGD context is already discussed.

In the context of the deterministic physics, theoretician encounters three rather unpleasant paradoxes.

a) The determinism implies that the unique objective reality corresponds to a single solution of the field equations. The first question is "What determines the initial conditions, say at the moment of the big bang?". The attempt to answer this question leads necessarily outside the physical theory: one possibility is to postulate anthropic principle. In TGD objective reality changes at each quantum jump and the localization in zero modes and Negentropy Maximization Principle imply a genuine p-adic evolution: therefore the recent objective reality is indeed an outcome of conscious selections.

b) The second paradox encountered by a theoretician is that in principle it is not possible to test a deterministic theory since only single solution of the

field equations is realized and a genuine testing would require the comparison of the time developments for various initial data. In practice this problem can be circumvented by assuming the existence of identical sub-systems having very weak interactions with the external world but in principle the problem remains unsolved. In TGD framework the hopping in the space of quantum histories makes possible the conscious comparison of the "solutions of field equations".

c) A further paradox relates to the dualism between theories and reality. Sooner or later theoretician is forced to ask about in what sense the theories exists. In TGD framework there is no need to postulate any further reality behind the theory. Quantum histories/configuration space spinor fields are what exists, model of reality is the reality. The hopping around in the space of these mathematical structures gives rise to the experiences of the pain and the concepts of toe and stone.

The famous Einstein-Bohr debate was related with the question whether God plays dice or not. In TGD context both were correct in their own ways. Quantum histories are indeed deterministic but God can replace the old quantum history with a new one: perhaps one should not however call this act dice playing but simply an act of free will. Einstein was also an advocate of local realism: this led to Einstein-Podolski-Rosen paradox created by the possibility of quantum entanglement between distant system. In TGD framework local realism holds true at the level of the infinite-dimensional configuration space but not at the level of space-time since point like particles are replaced with 3-surfaces.

The phenomenon of dissipation is paradoxal from the point of view of standard physics. It is generally accepted that the fundamental laws of classical physics are reversible whereas everyday reality is manifestly irreversible. Thus the situation is rather schizophrenic. Two worlds, the reversible and extremely beautiful world of the fundamental physics and the irreversible and mathematically rather ugly "real" world, seem to exist simultaneously. The quantum jumps between quantum histories concept solves the paradox and one can understand the dissipative world as an effective description forming an 'almost'-envelope for the sequence of reversible worlds (time developments).

4.3.2 Paradoxes related to the theories of consciousness

Chalmers describes in his book 'Conscious Mind' [29] several paradoxes related to the materialistic and dualistic theories of mind. A common denominator for these problems is the assumption that consciousness is a property of a physical state: hence these paradoxes disappear in TGD context. These paradoxes are encountered also in the quantum theories of consciousness identifying consciousness as a property of a macroscopic quantum state, say Bose Einstein condensate.

In the materialistic theories of mind, postulating a unique objective reality, consciousness is an epiphenomenon and free will is necessarily a peculiar illusion

and one can always ask why the consciousness is needed at all. Nothing changes in the physical reality if consciousness is dropped away. It is also very difficult to understand how the contents of consciousness are determined by the state of the material world.

In the dualistic theories postulating a unique objective reality (say the theory of Chalmers [29]), the problems are related to the coupling between matter and mind. The basic problem of the dualistic theories is what Chalmers calls hard problem: how the physical processes in the brain give rise to conscious experience? If the laws of the physics determine the behaviour of the system completely then one ends up immediately either with a complete separation of the mind and matter so that our conscious experience tells nothing about the material world or with materialism and epiphenomenalism. One can also consider a non-trivial coupling between matter and “mind like” fields but assuming a deterministic physics one ends up with a situation in which the mind fields are effectively just additional physical fields and consciousness is again redundant.

In TGD framework, which could be called tripartistic, hard problem and other problems of the dualistic theories disappear since there is no need to assign consciousness to quantum history. Moment of consciousness as quantum jump between quantum histories hypothesis allows even to define measures for the information contents of the conscious experience despite the fact that one cannot write explicit formulas for the contents of conscious experience.

4.3.3 Logical paradoxes and concept of time

Many logical paradoxes could be resolved if one assumes that there are two times: geometric and subjective and that the space-time surface providing linguistic representations changes quantum jump by quantum jump. In particular, during the conscious argument leading to the logical paradox!

The objections of Uri Fidelman [30] against the Platonic vision about reality involve the paradoxes of the cyclic cosmology (one might think that Turing machine in cyclic cosmology might be able to ‘know’ whether it has halted immediately after starting and thus be much more powerful than ordinary Turing machine). Basic paradox is that in cyclic cosmology allowing time travel one can imagine a psychopathic son who murders his mother.

It is interesting to consider this paradox as resulting from identification of the identification of subjective time with geometric time, which I see only as an approximation. In TGD the counterpart of time travel would be sequence of quantum jumps changing the entire classical history quantum jump by quantum jump and inducing the shift of the space-time region, where the contents of consciousness of time traveller are concentrated, to the geometric past. No paradoxes result since space-time is not a fixed arena of dynamics but changes in each quantum jump.

As a second example one can take the second objection of Uri Fidelman [30] against Penrose's program known as Berry's paradox.

Non-formalizable theory cannot provide a model of the physical world which includes the brain's cognitive function, since such a model must be lingual, written or spoken. However, such a model implies the following paradox of Berry: Let n be the smallest number which cannot be defined by an English sentence having less than, say, a hundred letters. This number exists, since the number of all possible combinations of a hundred letters is finite. Nevertheless, it has just now been defined by a sentence comprising less than a hundred letters.

Berry's paradox could be understood when the piece of text is seen as inducing a sequence of quantum jumps in which the space-time region at which the argument is represented symbolically changes. For the initial space-time region representing my cognitive state there is indeed smallest number n which cannot be defined by using less than one hundred words (using the English in that space-time!). After reading the statement quantum history is replaced by a new, more complex one in which this number can be defined by using less than one hundred words since a new reflective level of cognitive consciousness has emerged and is represented at space-time level.

This example encourages to think the possibility of replacing the idea of a fixed axiomatic system with a living and dynamically evolving system becoming conscious of new axioms from which new theorems can grow. Mathematician would not be anymore an outsider but an active participator affecting the mathematical system he is studying. For instance, when paradoxal statement represented symbolically becomes conscious in quantum jump sequence, also the context in which it was originally stated changes. This dynamical view about mathematical system could allow to solve antinomies.

4.4 Comparison with the approach of Barbour

The comparison of TGD based view about time with that of Barbour might help to understand what distinguishes TGD view from quantum general relativistic view. Barbour has proposed in his book "....." [31] that time is illusion. Barbour is a proponent of canonically quantized general relativity, where the canonical quantization rules eliminate time completely from the formulation. This reflects that fact that the dynamical arena is the space of 3-geometries rather than 4-geometries. This is also the situation in the super-space approach of Wheeler, which served as an inspirer of the configuration space geometry approach in TGD framework. Barbour's conclusion that time is illusion is certainly counter-intuitive but perfectly logical if one identifies time as geometric time and takes canonically quantized general relativity completely seriously.

There are of course objections against this conclusion. General coordinate invariance is a four-dimensional symmetry and the notion of space-time is crucial in all practical applications of general relativity: therefore the disappearance of time from quantum theory tells that something has gone wrong. Indeed,

Schrödinger equation and canonical quantizations were derived originally for non-relativistic systems so that the application of the formalism in general relativity might lead to astray. Secondly, the mathematical formalism resulting exists only formally since the naive generalization of non-linear field equations to infinite-dimensional context fails.

Accepting for a moment the absence of geometric time, one can ask whether the experienced time could have a place in Barbour's universe. If one accepts the notion of quantum jump sequence also the space of 3-geometries, one would indeed have subjective time. In the transition to TGD Universe space-times become 4-surfaces and the geometric time would emerge automatically. The fundamental deviation from the canonical quantization is that the fundamental variational principle means absolute minimization, not only extremization of the action defining the theory. Besides allowing to get rid of the infinities of the local quantum field theories, absolute minimization implies generalized Bohr rules and assigns to given 3-surface (counterpart of 3-geometry) unique space-time surface. Even this is not enough for having the psychological time: the localization of conscious experience requires classical non-determinism (which becomes determinism if 3-surfaces are generalized to sequences of 3-surfaces with timelike separations). As found, also p-adic physics as physics of intentionality is required to understand the emergence of the psychological time.

5 Consciousness and time

The new view about time implies has quite far reaching implications. The notion of 4-dimensional body is the basic concept involved. One can understand long term memories as communications with the geometric past. Sensory perceptions can be seen as memories of magnetic body about the state of the material body in a time scale of a fraction of second. Also some other unexpected symmetries are predicted. Long term memory and precognition seem to be aspects of one and a same phenomenon. The same applies to psychokinesis and retro PK. In fact, both sensory perception, motor action, and memory can be seen as being based on the same mechanism if one accepts that personal magnetic body corresponds to "me". Libet's findings about active and passive aspects of consciousness provide empirical support for the notion of magnetic body.

5.1 Passive and active aspects of consciousness

The division of the aspects of conscious experience to active and passive ones is not so obvious as one might think. Sensory experiencing is more like building a piece of artwork than passive receipt of the sensory input and active processes like healing could be rather passive receipt of negative energy MEs from the patient so that the healee gets in this manner only metabolic energy and does the healing herself. It is also far from obvious whether precognition is passive

experiencing of the geometric future or psychokinesis actively affecting it.

A precise theoretical dichotomy, at least apparently analogous to active-passive dichotomy, however exists if one accepts that MEs provide the basic mechanism of remote viewing and intentional action. Negative energy MEs can induce mere entanglement making sharing of mental images possible. This would naturally correspond to the passive aspects of consciousness as far as the receiver of negative energy MEs is considered. The generation of negative energy MEs makes possible remote metabolism at the end of system generating the negative energy ME. The receiver of the negative energy ME, say precognizer would be the passive counterpart whereas its sender, say an area of left cortex suffering from under-nutrition as might be in the case of synesthesia, would be the active counterpart. One must be however cautious here. It is not at all clear whether one can talk about sender/receiver of the negative energy ME since entanglement is completely symmetric process. In the sequel it is assumed that the notion of sucking of negative energy does not make sense.

Low frequency MEs can also contain also high frequency MEs inside them and positive energy MEs of this kind are especially natural for the realization of active aspects of consciousness. Positive energy MEs could directly provide energy to the receiver. They can also induce bridges along which various particles leak between space-time sheets so that basic metabolic activities are induced and controlled remotely.

5.2 Sensory perception, motor action, and time

TGD view about sensory perception differs dramatically from that of the standard neuroscience in that sensory organs are carriers of basic sensory representations and the magnetic body rather than body or brain is the experiencer with which we can identify ourselves.

5.2.1 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 the article "Quantum model of sensory receptor" of this issue of JNLRMI. 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 [D7].

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 microtubules 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.

5.2.2 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. 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. Similar picture applies to sensory perception with motor organs replaced by 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.

5.2.3 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 [32, 34]. 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 [32, 33] 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 [33]. 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.

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

b) 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.

c) 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 [15]. 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.

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

Libet's experiments [34] about the strange time delays related to the passive aspects of consciousness have served as a continual source of inspiration and headache. Everytime 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 [D6]. 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.

a) 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.

b) 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.

c) 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

Consider now Libet's findings. According to the summary of Penrose in his book 'Emperor's New Mind' these experiments tell the following.

a) With respect to the psychological time of the external observer subject person becomes conscious about the electric stimulation of skin in $\sim .5$ seconds.

b) 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.

c) 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. 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! If the cortical stimulation generates sensory mental image at sensory organ by backprojection then one could understand the change of the time ordering as resulting from .5 second lapse for the generation of backprojection.

d) If the stimulation of the cortex begins in the interval .25 – .5 seconds after the stimulation of the skin, the stimulation of the skin is not consciously perceived. This effect is known as a backward masking. From the source it is not clear whether a minimal duration of .5 seconds of cortical stimulation is required for backward masking.

3. Explanation of Libet's findings

Consider now how one could understand these strange findings in the proposed model.

a) Visual and tactile sensory inputs enter into cortex essentially simultaneously so that the construction of symbolic representations at magnetic body is possible. The projection to the magnetic canvas by positive energy MEs and the generation of the magnetic quantum phase transition might quite well explain the time lapse of .5 seconds. The symbolic representation could contain also information about where to direct sensory attention. After this time interval negative energy ME possibly directing the attention to a particular part of the perceptive field would be generated and induce sharing of mental images .5 seconds in the geometric past. Note that this would automatically guarantee that symbolic and sensory representations at the magnetic bodies of sensory organs

correspond to the same value of the geometric time.

b) The stimulation of the cortex lasting at least .5 seconds would generate a backprojection to sensory organs. The minimal duration of .5 seconds for the cortical stimulation would seem rather natural in order to avoid backprojections due to random neuronal fluctuations. This would explain why the temporal order of the sensory experiences generated by cortical and skin stimulation is reversed when cortical stimulation starts before the skin stimulation.

c) Consider now how the backwards masking could be understood. The cortical stimulation could generate a negative energy ME sent to the sensory organ and editing its geometric past at temporal distance of .5 seconds and depleting energy resources so that sensory organ cannot receive negative energy ME from magnetic body during the period of the cortical stimulation. Magnetic body would become sensorily blind to the input from the corresponding point of skin. Sensory blinding could be a clever manner to signal to the magnetic body that backprojection is to be expected.

The stimulated point of the cortical map would share the sensory mental image instead of the magnetic body and also give rise to a back projection: sensory mental image would be conscious to cortex but not to us! Magnetic body and cortex could be seen as competitors for resources in this kind of situation. Perhaps the electric stimulation induces some kind of neuronal starvation and forces the neuron to generate negative energy MEs entangling it with the sensory organs.

5.3 Long term memories and time

TGD based model of long term memory requires no storage of memories of past to the brain of the geometric now. The memories are in the geometric past as dynamical self organization patterns and subject to changes.

a) In the case of active memory recall the desire to remember is communicated to the geometric past by sharing and fusion of mental images made possible by entanglement. In the case of episodal memories also the memory recall would result in this manner. For non-episodal memories the memory would be communicated from the geometric past using classical communications.

b) In the case of episodal memories active precisely targeted memory recall might be difficult since the entanglement with a correct mental image seems to require good luck. In principle it is possible to select the distance T to the geometric past where the memory comes from by selecting the fundamental frequency of ME. There are huge amounts of information, which is useless unless the person is an artist. Ironically, the loss of cognitive abilities would be compensated by episodal memories providing mental powers making an idiot a genius able to tell whether a given number is prime and to perform extremely complex calculations. A mild variant of the idiot savant phenomenon can be induced artificially by trascranial magnetic stimulation even in ordinary persons [35]. The miraculous memory feats of synesthetes and idiot savants, and

also sensory memories and strange abilities induced by electric and transcranial magnetic stimulation could involve the entanglement of the stimulated brain areas rather than that of magnetic body with sensory representations with brain areas taking the role of sucker of positive energy. In this kind of situation the starving magnetic body could send negative energy sensory MEs to a more distant geometric past and experience episodal memories instead of the sensory input.

c) Classically communicated memories are symbolic and thus the amount of information is minimized. They are also reliable since it is enough for the brain of the geometric past to share the desire to remember. If the desire is communicated to a wide temporal range in geometric past, some self of the geometric past is able to communicate the answer. Context sensitivity is the drawback of this memory mode. Memes defined as sequences of memes defined by sequences of 21 DNA triplets might define what might be called universal language helping to overcome the context sensitivity [D1].

d) Brains could also generate automatically classical signals about often needed declarative memories to the geometric past at various lengths of magnetic flux tubes. The memory recall would require only the tuning to receive the classical signal. This would require an organization of brain analogous to sensory areas so that a particular neuron group is tuned to receive signals from a particular distance to geometric past. One can also imagine a situation in which the communication of the memory from the past occurs as repeated communications over shorter time interval, somewhat like ordinary communications using radio stations receiving and resending the message. For instance, classical communications could circulate around the magnetic loops associated with the personal magnetic body or that of Earth's magnetic field much like neural signals in neural circuits. This would make the memory retrieval more reliable. The automatic classical communications could be also involved with the communications by active memory recall. The extreme situation would be the transfer of information from the geometric past like a news about some event in a population via communications between individuals. This mechanism would also establish the memory representation along the entire life span.

5.3.1 How to achieve precisely time-targeted communication to and from geometric past?

Negative energy MEs are ideal candidates for sending a signal to the geometric past and inducing entanglement and sharing of the mental image representing the desire to remember. The magnetic flux tubes of the personal magnetic body with sizes measured in light years in turn can act as waveguides along which the negative energy MEs travel. MEs are curvilinear and parallel to the flux tubes. Also negative energy em MEs are possible since negative energy MEs interact very weakly with external world in any case. Also the positive energy MEs sent to the direction of the geometric future as a response and representing classically

communicated declarative memories would propagate along magnetic flux tubes. The same magnetic flux tube could be used for both communications.

The simplest hypothesis is that there is a division of labor: Z^0 MEs and Z^0 magnetic flux tubes are quite generally responsible for memories related to motor actions and em MEs and magnetic flux tubes are responsible for the memories associated with sensory perception.

One can consider several variants about how long terms memories are realized as communications between geometric now and geometric past.

1. *Mirror model*

The original idea was that MEs could be reflected at the ends or kinks of a magnetic flux tube serving as kind of mirrors. The outcome was the mirror model of long term memory in which the signal from the geometric past represented by ME is reflected at the end of the magnetic flux tube of astrophysical size. In the similar manner also the negative energy ME would be reflected. The model was still based on the idea that "me" is the physical body or brain. The basic objections are that there is no convincing identification of the mirrors and there is no guarantee that the mirrored ME returns to the original brain.

2. *Loop model*

One can also consider the possibility that closed magnetic flux tubes associated with the personal magnetic body could function as wave guides for curvilinear MEs, so that MEs would automatically return to the brain if they propagate while attached to the boundary of a closed magnetic flux tube. Also this model is still based on idea that the size of the personal magnetic body is not much larger than Earth's size so that one can idealize "me" as brain, at least in the length scale defined by the time span of the long term memories. Furthermore, despite the fundamental similarity between motor action, sensory perception, and memory, the mechanism of long term memory would differ from the mechanism of motor action and sensory perception. A further serious objection is that MEs parallel to the closed magnetic flux tubes and representing closed topological light rays might not be allowed as solutions of the field equations.

3. *Brain and body as timelike mirror*

If one takes completely seriously idea about "me" as the magnetic body with size at least of order light lifetime which can be regarded as single quantum coherent structure, one ends up to a variant of the model a). First of all, the whole magnetic body becomes the experiencer and classical communications need not be spatially precisely targeted. Secondly, brain and body serve as timelike mirrors in the sense spacelike reflection is replaced with both spatial and temporal reflection. Negative energy ME characterized by frequency and wave vector is replaced with time reflected positive energy ME: $(-E, -k) \rightarrow (E, k)$ in the reflection. Ideal reflection changes only the sign of the normal component

of 3-momentum. If this is the case also now then also the magnitude of energy would be conserved so that the classically communicated memory would be automatically communicated to a correct temporal position in the geometric future.

If the transverse area S of flux tube codes for the temporal distance T to the geometric past by its transverse area ($T \propto S$) and thus by cyclotron frequency scale, the mechanism of long term memory becomes precisely identical with that of sensory perception and motor action. The desire to remember is communicated quantally from the magnetic body to brain along flux tube, and the reply arrives as a classical communication along same flux tube at the fundamental frequency and the reply communicated classically generates cyclotron transitions at the receiver's end at a correct temporal distance in future. In light of the fractality of consciousness, this model is certainly the unique one and is certainly consistent with the field equations.

The memory mental image communicated classically should reach the temporal position of the 4-D brain, which communicated the desire to remember. High precision communication is not absolutely necessary although it is favoured by metabolic considerations: it is enough that the memory is communicated to a time interval containing the temporal position wherefrom the desire to remember was communicated. Memory could even diffuse like an interesting news in a 4-D society formed by mental images in brains at different times.

If MEs are amplified by Alfvén wave resonance (closed magnetic flux tubes or flux tubes with ends), the wavelength of ME should correspond to the length of the magnetic flux tube involved. If negative and positive energy MEs are associated with same magnetic flux tubes and the thickness of the magnetic flux tube varies as $S \propto L$, cyclotron transitions occur automatically at a correct temporal and spatial position of the flux tube and the sender of the memory recall receives the answer. In this case however memory is communicated to some time interval in geometric future.

If temporally selective communication is required, the frequency associated with ME must correspond to the same time value for the negative and positive energy MEs involved. A relative precision of $\Delta f/f \simeq 10^{-9}$ is required if the time span of the memory is 10 years and precision about .1 seconds. Later a model of timelike reflection which could conserve the frequency with this precision will be discussed. Of course, the needed precision could be much lower and needed only if the "me now" for some reason has a paranoid tendency to hide its communications from the "mes" in the geometric past. The active loss of memories could result from the refusal or inability of the "mes" of the geometric past to communicate memories or of the "me" of now to generate memory recalls.

4. Variants of the time-mirror model

One can consider several variants of the time-mirror model.

a) If MEs correspond to interior MEs with phase velocity in excellent ap-

proximation identical with light velocity, the communication of the long term memory to the temporal position in future is easy. For communications with light velocity the lengths $L = cT$ of the flux tubes would be measured in light years for a typical time span T of long term memory.

b) The condition for reflection does not distinguish between interior and boundary MEs and in both cases the frequencies involved are ultra low. For boundary MEs the reply to the memory recall would be received by different part of the personal magnetic body with distance $L_B = vT = vL/c$ from brain but this could work if personal magnetic body behaves like a single conscious unit. For EEG phase velocities L_B would be of the order of the size of the magnetic body of Earth for typical values of T so that the declarative memory could be communicated also to the magnetic Mother Gaia responsible for the third person aspects of the memory.

c) What is intriguing that for a typical EEG phase velocity v the distance $L_B = vT$ travelled during T corresponds to a wavelength $\lambda = L_B = c/f_{high}$ of EEG wave propagating with light velocity. This brings strongly in mind the scaling law of homeopathy and its generalizations, and suggests that the boundary ME corresponds to EEG wave with EEG phase velocity v . This numerical coincidence encourages to consider also time like reflection in which energy is not conserved. The scaling law of homeopathy suggests that low frequency negative energy ME could transform in the reflection to high frequency positive energy boundary ME:

$$-f_{low} \rightarrow f_{high} .$$

This transformation could be interpreted in terms of the Alfvén resonance condition $f_{high} = c/L_B$ for a ME propagating in the flux loop of length L_B (recall however the objection against closed topological light rays).

d) Positive energy EEG interior MEs could propagate with light velocity along the closed loops of personal magnetic body of Earth's magnetic field and return again and again to brain very much like neural signals circulate in neural circuits. This would provide a manner to refresh often needed memories. The main theme of [D10] was indeed the fractal correspondence between the structures of the brain and magnetosphere.

e) Fractality suggests that magnetic loops of all possible sizes are involved with classical communications by boundary MEs, even the magnetic loops of the material body serving as templates for neural circuits. The requirement that frequencies are identical for these fractally scaled magnetic circuits could be seen as an entrainment phenomenon. This would predict ultraslow neural signals serving as correlates for the classical communications of long term memories at brain level. It is indeed known that Ca_{++} have extremely wide velocity spectrum [36].

5.3.2 Four basic types of memories

For the time-mirror model of long term memory the ULF must be generated both at the personal magnetic body and in the brain. At the personal magnetic body cyclotron transitions of protons and electrons would generate the needed MEs since the densities of heavier particles are extremely low in outer space. At the Z^0 magnetic body the cyclotron transitions of neutrons and neutrinos or of their Cooper pairs could generate Z^0 MEs. (p,e)-(n- ν) dichotomy would naturally naturally correlate with sensory-motor dichotomy.

The energies and magnetic field strengths involved are extremely low.

a) In the case of protons for which the Earth's magnetic field $B_E \simeq .5$ Gauss corresponds to cyclotron frequency of 300 Hz, time span $T \sim 30$ years requires magnetic fields $B \sim 10^{-11} B_E$: the thickness of quantized magnetic flux tube would be about 1 meter. That the upper bound for the size of the protonic flux tube corresponds to that of the material body would mean that the flux tubes of the personal magnetic body would have maximal transversal dimensions comparable to that of the physical body. This would make scale-faithful representations of the physical body at the transversal sections of the magnetic flux tubes.

b) For electrons the thickness of the magnetic flux tubes would be about 50 meters for $T \sim 30$ years. If electrons and protons correspond to flux tubes of the same magnetic body, electrons must be responsible for memories in time scale shorter by a factor of $m_p/m_e \simeq 2^{-11}$. For $T_{max,p} \sim 100$ years of protonic memories this would mean $T_{max,e} \sim 18$ days. Perhaps short term memories correspond to electronic Cooper pairs.

c) Also the Z^0 cyclotron transitions neutrons and of neutrino Cooper pairs at Z^0 magnetic flux tubes could be involved with memory representations. For neutrons the time scale is same as for protons. For neutrinos the time scale $T_{max,p} = 100$ years would be scaled down by the factor $m_\nu/m_p \sim 10^{-10}$. This gives time scale of $T_{max,\nu} \sim .1$ seconds which is nothing but the duration of the memetic codeword assumed to be represented in terms of cognitive neutrino pairs in TGD based model for cognition! Thus the interpretation as working memory involved with cognitive processing might make sense.

5.3.3 A model of time-mirror based on spin glass degeneracy

Spin glass degeneracy suggests a general mechanism for the time-like reflection. The personal magnetic and Z^0 magnetic bodies would realize their intentions in terms of reverse cyclotron transitions. The negative energy ULF MEs generated by reverse cyclotron transitions at the magnetic body would induce radiation-less transitions between almost degenerate states of a spin glass system in brain. These transitions would serve as seeds of quantum phase transition analogous to BE condensation generating a cascade of positive energy MEs needed to communicate the declarative memory classically. An ideal reflection conserving the

magnitude of ME frequency and thus guaranteeing a precise temporal targeting would be an automatic outcome. The transition could be accompanied by the dropping of ions and even molecules from atomic space-time sheets to magnetic flux tubes generating boundary MEs at EEG frequencies responsible for the classical communication of memories electromagnetically along flux tubes with length $L = vT$.

ULF MEs would most naturally correspond to the change of the classical gravitational energy ΔE_{gr} in a transition between degenerate quantum spin glass states for which only classical gravitational energy differs so that the induced Kähler field does not change. ΔE_{gr} would correspond to the change in the interaction energy of Kähler field with the classical gravitational field. The transition would correspond to a canonical transformation of CP_2 localized with respect to M_+^4 coordinates. Classical Z^0 field energy would transform to classical electromagnetic field energy or vice versa in the process. Also color rotations would mix classical em and Z^0 fields but in this case classical gravitational field would not change.

TGD predicts that the induced Kähler field couples to the classical gravitation with a coupling strength which is almost 10^8 times stronger than Newtonian gravitational constant. The classical Z^0 electric field energy of condensed matter system without neutrino screening at $k = 169$ space-time sheets in the absence of neutrino screening is of the same order of magnitude as the classical gravitational interaction energy of matter. Thus the energy liberated or needed by the canonical transformation of the system could well be a reasonable fraction of the ordinary classical gravitational energy. This would suggest that the Z^0 and em fields reside at the space-time sheets $k = 151, 157, 163, 167$ and 169 , the first four of which correspond to the Gaussian Mersennes.

For a spherical blob of matter having size between cell membrane thickness and cell size the gravitational energy would correspond to T in the range .1 seconds-100 years. In the case of linear systems like microtubules the upper bound for microtubule length is about $100 \mu\text{m}$. Neutrino Cooper pairs responsible for the strength of Z^0 screening could reduce to canonical transformations controlling the contributions of electromagnetic and Z^0 fields to Kähler field at the space-time sheets involved.

5.4 Remote mental interactions and time

If the notion of magnetic body is taken completely seriously, sooner or later comes the realization that not only motor action, sensory perception, and memory, but also various forms of remote mental interactions could be based on essentially the same mechanism. Motor action and memory recall certainly involve the active aspect but so does sensory perception via direction of attention and selection between percepts.

Magnetic bodies are the intentional agents, and accompany even "non-living" targets. The intention of the magnetic body to achieve something is

transformed first to a negative energy ME representing the communication of the desire to achieve something to the geometric past by sharing of mental images. Already the sharing of mental images might be enough, as in the case of remote viewing of the geometric past, in special case long term memory. Then the receiver of the negative energy ME, be it lower level magnetic body or material body, tries to realize the desire and generates classical signals. These signals could be also positive energy MEs and could propagate back to the magnetic body as in case of declarative memory recall. They could also propagate to another magnetic body, which would mean that mind-mind interactions are involved.

This unified view means that the distinction between active and passive aspects of remote mental interactions is far from trivial, and it is not so easy to tell where the boundary line between precognition and psychokinesis is. The first realization along these lines was that precognition and long term memory are different aspects of the same phenomenon. Then came the idea that also PK and retro PK could be seen as different aspects of the same phenomenon if PK can be regarded a generalized motor action in which target becomes effectively part of the body of the psychokinesist.

5.4.1 A possible view about remote viewing

The basic question is whether negative energy MEs are always generated actively by the system in the geometric future or whether also active sucking of the negative energy from the geometric future is possible. The simplest assumption is that the sucking of negative energy is not a sensical concept. The motivation comes from the fact that it seems to be impossible to distinguish between sucking and passive receipt of the negative energy since the entangled systems are in a completely symmetric position.

1. *Active and passive aspects*

Whether one can regard remote viewing as active or passive process depends on whether it is geometric past or future which is viewed.

a) If geometric future is viewed, the task of the remote viewer is to tune to the "correct wavelength" in order to be able to receive the negative energy ME from the geometric future. This requires that remote viewer tries to get rid of mental images competing for the metabolic resources and tend to mask the viewed mental image. The initiative is possessed by the system in the geometric future sending the negative energy ME. The reaction of the remote viewer realized as classical communications could give rise to PK effect in the target. If the time-mirror mechanism based on induced phase transition is involved also with remote viewing, the reaction of remote viewer would be automatic so that some kind of PK effect would be unavoidable.

One cannot completely exclude the possibility of time reversed classical communications. In ordinary classical communications the high frequency positive

energy MEs absorbed by the receiver kicks it to a higher energy state wherefrom it returns to the ground state spontaneously. A system receiving high frequency negative energy MEs inside low frequency negative energy ME can drop to a lower energy state only if the magnitude of the energy is below thermal energy or if the system is analogous to population inverted laser. In the latter case the receiver would not however return spontaneously to the original state unless there is a feed of energy to the system.

b) If the geometric past is viewed, the process is active process and completely analogous to long term memory recall except that negative energy MEs generated by the remote viewer are not received by the brain of the viewer but some other system. Note that now also classical communications are possible and would be analogous declarative memories. These communications might be possible if the target is living system and be based on memetic code using the common vocabulary defined by common memes [D1].

2. Sharing of mental images

Since remote viewing by the sharing of mental images does not involve classical communications at all so that one cannot characterize the process in terms of bit currents. There are indeed arguments that if the field patterns of EEG waves were responsible for the remote viewing realized as classical communications, the bit rates required would not be high enough since the frequency defines an upper bound for the bit rate [37].

Sharing of mental images does not pose any obvious upper bound for the amount of conscious information transferred. Measures for the amount of information contained by mental image could be provided by the number theoretical information measures predicted by TGD approach [C2, C1].

What would be communicated would be more like impressions instead of messages consisting of symbol sequences. The message, say visual perception, would contain huge amounts of irrelevant information. Of course, the mental images could be also cognitive or symbolic representation, say internal speech. The translation of these impressions to language involves cognition and analytic thinking and can lead to misinterpretations. The reports about telepathic communications suggest that mental images transferred in telepathic communications are fragmented: more like sensory and emotional impressions and often what might be regarded as separate "features" of the perceptive field rather than complete percepts. If sensory organs are the seats of the sensory representations, telepathy should thus involve entanglement of the viewer with the brain of the sender containing the symbolic representations. Fragmentation would reflect that fact that brain does for sensory input same as catabolism makes for food.

It is known that the entropy gradients associated with the target correlate with the probability that target is remote viewed [38]. In TGD framework this can be explained as a basic characteristic of conscious experience [D7]. All gradients, also spatial gradients, such as textures of visual field or gradients

of illumination at particular wavelength, are transformed to subjectotemporal gradients and only changes are perceived in accordance with quantum jump as moment of consciousness identification. In TGD Universe the intensities of emotions are proportional to the gradients of entropies associated with various quantum number and zero mode increments and only objects generating strong enough emotional response catch the attention. Targets with low entropy gradients do not generate intense mental images in any perceiver (not necessarily human!), and thus do not generate remote perception by a sharing of mental images.

3. Remote viewing is not only viewer-target phenomenon

Remote viewing does not seem to be only a viewer-target phenomenon but involves many-brained magnetospheric selves receiving information from the brains involved with the typical experiment whose protocol is such that viewer does not know the location of the target. In particular, the ability of the remote viewer to view target about which he knows only coordinates having no significance as such to him but for someone involved with the protocol supports this view [12]. Also the reported healings induced by prayer groups and meditation groups whose members do not know the healees and even where they are, support the same conclusion [13]. Thus remote viewing as well as healing might involve multiple entanglement. For instance, healer would be entangled with higher level self in turn entangled with the healee. Fractality suggests that one could apply the wisdom about brain functioning to the modelling of the multibrained selves. The notion of associations might make sense for instance. The analogy with brain encourages to think that also classical communications by positive energy MEs might be involved and make possible feedback and thus PK.

An interesting practical question is how to characterize the strength of the entanglement by negative energy MEs. The lifetime of the resulting bound state is one such measure. One could guess that this time scale is of the order of the relevant p-adic time scale. Somewhat paradoxically but in consistency with Uncertainty Principle, the duration would be the longer, the weaker the binding energy would be. Second measure is the number of MEs involved. If collective multibrained selves are involved the number of brains involved and having information about target would be a significant factor.

5.4.2 Sharing of mental images as the basic mechanism of remote viewing

Sharing of mental images does not require neither target nor receiver to be able to communicate symbolically. Therefore the target and receiver could be any living system: animal, plant, even bacterium. In TGD Universe one cannot exclude even "non-living" systems as targets and even sharers of mental images. The remote viewing of non-living targets is indeed possible and in this case either

mental images of target or some system perceiving target are shared.

Support for the extreme generality of the sharing of the mental images as a basic mechanism of remote viewing comes the fascinating experimental discoveries made by Cleve Backster [39, 40]. These findings have led Backster to introduce the notion of primary perception, which seems to have a natural identification as sharing of mental images.

a) Plants, eggs, and even bacteria are able to have primary perceptions. Backster tells in the interview that even yoghurt got wild when he took a chicken out of refrigerator and began pulling off strips of meat. Plants respond electrically to strong negative emotions and to the violence or death suffered by other living organisms. That primary perception correlates with the strength of emotions conforms with the view that entropy gradients with respect to subjective time, which are indeed identifiable as emotions, measure the strength of perception.

b) Distance does not seem to matter much. Sperm separated by a large distance from its donor reacted when the donor inhaled amyl nitrate. White cells were found to remotely react to the emotions of their donors. Same was found to apply to plants and their owners.

c) Plants and even bacteria seem to have a defence mechanism resembling shock. If bacteria share the mental images of suffering organisms by receiving negative energy MEs sent by them, the shock could be interpreted as resulting from the depletion of positive energy resources (all excited states of population inverted many-sheeted lasers decay to the ground state) or be a mechanism preventing this depletion.

An interesting question is whether humans have lost this ability or is this reaction usually unconscious at our level of self hierarchy and whether human skin could exhibit GSR to say death of other lifeforms.

5.4.3 Precognition and memory as different aspects of the same phenomenon?

It is tempting to see precognition and long term memory as different aspects of the same phenomenon involving sharing of the mental image resulting as fusion of mental images by time-like entanglement induced by negative energy ME.

a) This identification would explain why precognition is a rare instance whereas memories would pop up more or less spontaneously. The reason is that precognition means giving energy to the future self whereas memory means receiving it. During wake-up period brain has to utilize its metabolic energy to build sensory representations, to plan and realize motor actions, and cognize. Therefore not much energy is not available unless these activities are silenced. This kind of silencing is indeed a prerequisite for precognition [12].

b) Sleep state is for metabolic reasons ideal for precognition. During sleep state it is however the larger self resulting as a fusion of brain with some other self which precognizes, so that these precognitions are usually not remembered. It should be however possible to precognize during dreams, especially so during

lucid dreaming. The problem is that dreams are forgotten very rapidly unless they are documented immediately. The classic work "Experiment with time" of Dunne provides strong support for the prediction that dreams can be precognitive [41]. Also Joe McMoneagle has told in his book about heightened precognitive abilities during lucid dreaming [12]. Probably almost anyone has had dreams which develop logically to the ringing of the alarm clock.

c) In this picture the one who remembers, that is generates negative energy ME, is a natural candidate for the active participant in the process. Therefore precognizer can only calm his/her mind and try to "tune at the same wavelength" in order to entangle with the self of geometric future and try to eliminate the mental images that would mask the precognized one and compete for metabolic resources. The tuning to the same wavelength has quite literal meaning since the fundamental frequency of ME determined by its temporal duration characterizes what might be called the extension of the memory field. There is indeed evidence for the notion of memory field [42]. If memory and precognition are aspects of the same phenomenon then also the notion of precognitive field makes sense.

5.4.4 PK and retro PK as different aspects of the same phenomenon?

The idea that PK is just motor action with target taking the role of the motor organs leads to a new view about PK and retro PK.

a) Ordinary motor actions are initiated by higher level selves by sucking negative energy from motor organs and the process proceeds upwards in CNS to the direction of geometric past wherefrom classical response comes from. In the case of PK this would mean that psychokinesis would be initiated by psychokinesists by sucking energy from the target by sending negative energy MEs to the target. Target would in turn generate negative energy MEs send most naturally to motor organs or perhaps skin of the psychokinesist. This could induce the flow of various particles to say atomic space-time sheets, where they can induce dissipative effects. This and the universality of metabolism based on zero point kinetic energies forces to consider quite seriously the possibility that almost any system can be a conscious experiencer or an intentional agent.

b) The most straightforward effect of the psychokinesist on the target is to provide energy by remote metabolism as quanta defined by the universal energy currencies dictated by the p-adic length scale hypothesis irrespective of whether the target is living or not. MEs can also play a role of mere control function by acting as bridges along which particles can flow between various space-time sheets but not accelerating the charges. The flow of particles between say magnetic flux tubes and atomic space-time-sheets induces a recoil effect and the explanation for the report of Modanese and Podkletnov [43] about a new kind of radiation which induces motion of material particles without giving them appreciable energy, supports the view that this recoil effect can

induce macroscopic motion. Also the model for the PK effects induced by Russian psychokinesists in charged objects at table near the critical potential inducing discharge leads to the idea that the flow of ions between space-time sheets inducing recoil effects is responsible for PK effect [C4]. Psychokinesist would provide the energy needed for the control of motion but that part of the momentum could come from (say) magnetic flux tubes carrying the ionic supra currents.

c) The idea about long term memory and precognition as different aspects of the same phenomenon generalizes. Psychokinesist would perform PK to the target while target would perform retro PK to the psychokinesists. It is not easy to distinguish between motor action, PK and precognition nor between sensory experience, retro PK, and memory. Psychokinesist could be said to actively suck positive energy from the target in PK and passively receives positive energy in remote viewing. The direction of the classical communications possibly involved would be a second criterion. In the case of PK the possible classical signals would be generated by psychokinesists, In the case of remote viewing of the geometric past by the target.

In the famous chicken-robot [44] experiments chicken was imprinted to a robot with the consequence that the robots motion in room coded earlier to a random number sequence changed so that the robot tended to stay near chicken. In this case one could say that chicken performed retro PK in the computer program responsible for generating the random number sequence or sequence itself by generating negative energy MEs. The resulting PK effect on chicken was at the level of chicken brain and provided for chicken metabolic energy. Perhaps the interaction between child and parents involves a similar transfer of energy.

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5.4.5 From remote viewing to quantum remote sensing?

Ordinary remote sensing technology is limited by the finite velocity of light making it impossible to remote sense actively objects that are too faraway. Time mirror mechanism not only makes it possible to survive utilizing .3-.5 seconds old sensory data but also suggest a technology of active remote sensing based on time reflection at the studied object and thus involving no time lapse,

and making possible remote sensing of arbitrarily distant, even astrophysical, objects.

A phase conjugate laser wave would travel to the geometric past and time-reflect back as an ordinary laser wave from an object containing population inverted many-sheeted laser mirrors. The only additional condition is the presence of the many-sheeted population reversal. This condition could be satisfied for living matter at least.

Dela-Warr camera [45] might be based on this mechanism. Even more science fictively and a little bit of tongue in cheek, one can consider also the possibility of communicating with the civilizations of the geometric future by using population inverted lasers. Send to the geometric future classical k -bit signals (k harmonics of the fundamental) at p -adic frequencies $f(n, k)$ to tell that we have discovered p -adic cognitive codes, and wait whether the population inverted lasers at these frequencies return to the ground state with an abnormally high rate! One can easily imagine simple codes for communication. For instance, for p -adic length scales corresponding to visible wavelengths the typical number of bits would be 163.

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