

# Magnetic Sensory Canvas Hypothesis

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## Abstract

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

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

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

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

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

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

d) Dark matter hierarchy based on a hierarchy of increasing values of Planck constant predicts a hierarchy of generalized EEGs. The generalized EEGs make it possible for the magnetic bodies to receive sensory information from biological body and quantum control it. The resulting detailed model of ordinary EEG predicts correctly the band structure and narrow resonance bands.

## 1 Introduction

There are very general objections against the idea that the ultimate sensory representations are inside brain. For instance, any computer scientist, unless informed about materialistic dogmas, would argue that the processing of the sensory data must be separated from its representation. How this could occur if sensory and other representations are realized inside brain, is however difficult to see. The classical experiments of Libet relating to the active and passive aspects of conscious experience [20, 21, 22] provide a strong empirical support for the view that signals from central nervous system (CNS) spend .3-.5 seconds to propagate somewhere else. If the propagation occurs with the velocity of light, the distance in question is measured using the circumference of the Earth as a natural unit.

### 1.1 Sensory canvas hypothesis

In TGD approach these objections lead to the view that the magnetic flux tube structures associated with the central nervous system (CNS) could define a hierarchy of sensory, symbolic, and cognitive representations outside brain with magnetic flux quanta of the magnetic bodies serving as the canvas to which place coding by magnetic frequency generates sub-selves (mental images about "simple feeling of existence") and associates with them various sensory qualia and symbolic and cognitive features by quantum entanglement. Thus brain could be much like a RAM memory containing a collection of features in random order and the ordering would be induced only by the sensory map to

the magnetic sensory canvas. Are our sensory representations at the magnetic flux tubes of Earth's magnetic field or are personal magnetic bodies needed? Since space travellers experience the world very much like us and have survived, the most plausible conclusion is that the magnetic sensory canvas is personal. This conclusion is also supported by the fact that the value of the magnetic field explaining the harmonics of 15 Hz as  $\text{Ca}^{++}$  cyclotron frequencies is .2 Gauss rather than .5 Gauss.

## 1.2 Why the world is not experienced to rotate as head rotates?

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

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

1. the objects of the perceptive field induce sensory mental images (sub-selves) already at the level of sensory organs (in particular, retinas) and representations at corresponding magnetic bodies;
2. these mental images, being self-organization patterns, whose boundaries are determined by the gradients of illumination, do not rotate as the head or eye rotates;
3. the points of the retina correspond to fixed points of the visual cortex in topographic manner;
4. the projections to the sensory magnetic canvas from the visual cortex occur orthogonally;

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

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

Some comments about terminology are in order. Sensory representations involve besides the primary sensory qualia the symbolic representations constructed by brain giving meaning for the sensory input. I will use also the

phrase "cognitive representation". Space-time correlates for cognitive representations are tentatively identified as p-adic space-time sheets coinciding with real space-time sheets in resolution defined by some cutoff length scale: in general the intersection with real space-time sheets is discrete set of rational points common to reals and p-adic number fields. p-Adic space-time sheets are also identified as correlates for intentions and the realization of intention as action is tentatively identified as a quantum jump replacing p-adic space-time sheet with a real one in such a manner that conservation laws are satisfied.

### 1.3 Model for the sensory representations

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

1. Sensory qualia are at the level of primary sensory organs having their own magnetic bodies and entangled with the cognitive and symbolic representations of the perceptive field in brain in turn entangled with the points of the sensory magnetic canvas. The entanglement between primary sensory organs and brain and TGD based view about long term memory resolves the basic objections against this view, and one can understand the differences between sensory experience, imagination, dreams, and hallucinations and various strange phenomena like synesthesia, Anton's syndrome, and blind sight.
2. Second essential element is the mirror mechanism of long term memories. To remember something in the geometric past at temporal distance  $T$  is to look at a magnetic mirror with length  $L = cT/2$ . At quantum level quantum entanglement is involved and means sharing of mental images between recent me and the me of the geometric past (or some other self responsible for the memory representations). This requires that magnetic flux tubes involved with long term memories have astrophysical lengths with light year being the natural length unit. For magnetic fields this indeed makes sense. This picture is of course dramatically over-simplified. A more realistic model of long term episodal and declarative memories in which the magnetic body uses time mirror mechanism by sending entangling negative energy ME to the brain making possible sharing of mental images. From brain negative energy MEs are time reflected back as positive energy MEs and are possibly amplified. Positive energy MEs can give rise to classically communicated declarative memories. This means that the distance along a flux tube of the personal magnetic body codes for the temporal distance to geometric past.
3. The already mentioned findings of Libet about strange causal anomalies related to the passive aspects of consciousness lead to the conclusion that sensory experiences are geometric memories of the personal magnetic body in time scale of .3-.5 seconds about what happens in at the level of material body. Libet's findings about active aspects of consciousness in turn allow to conclude that also motor activity must involve time mirror

mechanism with negative energy topological light rays sent to the geometric past and inducing the neural activity as a response. Without this mechanism we could not survive using .3-.5 seconds old sensory data. A beautiful general scenario for the realization of intentions and unifying sensory perception, long term memories, and motor action emerges and allows to explain phenomena like sensory rivalry difficult to understand in neuroscience framework.

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

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

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

#### **1.4 EEG as a communication and control tool of magnetic body**

The progress made during the year 2005 in the understanding of the dark matter hierarchy stimulated a quantum leap in many branches of TGD with the model of the magnetic body included. This forced some updating of also this chapter although I tried to not destroy the original flavor of the chapter. I also added a section about about a hierarchy of generalized EEGs associated with the dark matter hierarchy making possible for the magnetic bodies to receive sensory information from biological body and quantum control it. The chapter "The Hierarchy of Generalized EEGs and Dark Matter Hierarchy" [M3] provides a detailed vision about magnetic body as an intentional agent receiving sensory input from the biological body and using it as a motor instrument.

In this chapter a general vision about the magnetic sensory canvas hypothesis is discussed. The discussion continues in [N1]. These chapters are not a reviews of the final results after the dust has settled but document the development of ideas as it has occurred and is still occurring. There are many mammoth bones and little inconsistencies, and often the simple final picture is achieved by a lot of painful sidetracking. The very name "Magnetic sensory canvas hypothesis" of this chapter is a good example of this problem: both symbolic, cognitive and sensory mental images entangle with the magnetic body so that the attribute "sensory" is somewhat misleading. Furthermore, motor control aspect is equally important. Perhaps a better title would be "Magnetic body hypothesis". My sincere apologies for the reader for this: I can do only my best!

## 2 Where me is?

A concrete model of consciousness requires a specification of the self that I am used to call "me". The standard neuroscience approach would not hesitate in identifying "me" with the neural activities or of their seat and thus localizing it inside head. The notions of the many-sheeted space-time and ELF ME allow to take a fresh look at the problem.

### 2.1 Is "me" outside my body or does it contain it?

There are several both TGD based arguments and arguments based on basic facts about sensory experiencing supporting the view that "me" is not completely inside my head or physical body. More precisely, it might be possible to identify visual and auditory fields more or less as an extension of my body as the following arguments suggest.

1. p-Adic cognitive maps discussed [E6] map typically inside to outside and vice versa. Does this imply that the cognitive and sensory maps of the external world are outside my body? Am I looking the sensory image of the external world in the spherical mirror provided by my brain. I know that the image of the external world is in question but I do not realize that I am not that image. Of course, "me" could contain also the body and the sensory mental images about body would be located in body region and help to generate the illusion that I am nothing but my body, or actually brain as well-informed neuroscientist would believe. To get rid of the mirror illusion one must break the mirror and physical death is the final manner to achieve this. Near death experiences indeed involve the experience of looking one's own body from outside (these experiences are discussed in [H8] and [I3]).

A further interesting point is that imbedding-space points p-adically near to each other are faraway in the real sense. Simple intentions have p-adically small space-time sheets as their correlates and corresponding desires represented by their real counterparts have a maximal number of

rational imbedding space points in common. Thus simple desires have large real space-time sheets as their correlates. Therefore astrophysical and even cosmic length scales are natural for cognition and intention, and the evolution of cognition from small to large length scales in a p-adic sense corresponds to the evolution from long towards short real length scales like a carving of a statue by adding details. The learning of a motor skill proceeding from clumsy whole-body movements to refined movements involving a minimal number of body parts is an excellent example of this aspect of cognitive evolution.

2. The paradigm of four-dimensional brain leads to believe that long term memories are perceptions with the objects of the perceptive field located in the geometric past (and Libet's experiments lead to the conclusion that sensory percepts are memories in time scale of .5 seconds!). But why not also the objects of visual and auditory field *spatially* external to me should not be sensorily represented outside my body. Same applies also to the parts of body external to the brain. This leaves several options. For instance, fundamental sensory representations could be realized using entanglement with the objects of the perceptive field as an auxiliary tool to deduce distances and sizes of objects of the perceptive field. Perceptive field would in some sense become a part of its sensory representation. It could also be that sensory representations occur at magnetic bodies and in quite different length scales.

We indeed experience external world like an external observer looking at the projection of the image of the external world on a sensory canvas defined by brain: the orientation or motion of canvas does not matter.

## 2.2 Sensory canvas hypothesis and some problems related to sensory representations

There are several basic problems related to the sensory representations, which could be solved if "me" is outside my body.

### 2.2.1 Problems with reference frames

The problems related to reference frames associated with retina, head and body result if one assumes that the reference frame of the conscious observer is that of brain as is natural to assume if brain is the seat of conscious experience.

1. Retina defines the reference frame for patterns of neural activity and topographical mapping of neural activity in retina to the visual cortex means that the motion of eye induces a motion of the pattern of neural activity inside brain. Why saccadic motion or larger scale rotation of eye (resulting from the change of the direction of gaze) does not give rise to experienced motion of the external world relative to head?

2. Also my head and body can move. Why I do not experience world moving around when I turn my head or move my body? The picture of world at the surface of cortex changes its position certainly. It is difficult to imagine how brain could be able to compute and make the corrections cancelling *totally* this sensation.

Essentially brain is able to experience the external world as it would look like if seen from outside with eyes and brain serving as a moving canvas at which the visual information is projected. That is: the conscious observer effectively looks the situation, not in the reference frame of the head, but in the reference frame of the environment. As if the sensory representation (defined to include also symbolic and cognitive aspects besides purely sensory aspects) would be realized outside cortex at some kind of canvas stationary with respect to head by utilizing the topographic map between retina and visual cortex, and by projecting data from the visual cortex in a direction orthogonal to it. Although the head and canvas rotate, the projected sensory picture realized as a self-organization pattern, would remain stationary.

### 2.2.2 Problems related to stereovision and perspective

There are also problems related to the stereo vision.

1. How the position coordinate of the objects of the external world orthogonal to the retina is represented in cortex. How the three-dimensional representation is possible inside the very thin cortex? It seems that there is a projective mapping involved mapping the exterior of sphere to its interior but how can we experience the inverse of it, if the inverse mapping is not realized physically somehow?
2. The standard argument is that stereo vision produces three-dimensionality, is not totally convincing. Contrary to what text books tell me to experience, I stubbornly see three-dimensionally also using single eye (I have not tested how long this heretic sensory perception lasts). Note that one must make a clear difference between stereo vision as sensory experience and as cognitive experience with information about distances.
3. There is no doubt that the distances of objects of the perceptive field are determined somehow by brain but how they are represented consciously? Again, a projection to the external world is the most natural manner to represent the result of the computations realistically.
4. If sensory representations are realized outside brain, the phenomenon of the perspective would become trivial since it is the basic aspect of projective geometry. More precisely, the distance resolution  $\Delta L$  for the objects of perceptive field is essential. The angular resolution for objects decreases as  $\Delta\theta = \Delta L/R$  as a function of distance of the objects so that very distant objects with a given spatial separation cannot be resolved for each other.

If the tracks of the railroad cannot be resolved very far from each other, it is natural to expect that they are experienced to converge to single point.

### 2.3 Are the primary sensory organs the seats of sensory qualia?

There are also many strange facts about sensory perception, which cease to be so strange if "me" is outside my body or rather, contains it. The most elegant picture results when one assumes that primary sensory qualia are seated at the level of sensory organs, and entangle with the cognitive and symbolic representations produced by brain. These mental images in turn would entangle with the magnetic body of astrophysical size.

1. Imagination could be understood as perception without sensory qualia. During dreaming and presumably also hallucinations the back-projection into eyes would "qualify" the symbolic representations. The movements of eyes during REM sleep could be understood as a part of this process. Similar phenomenon is associated also with ears: here  $Z^0$  magnetic flux tubes might be involved with the back projection and auditory canvas might be  $Z^0$  magnetic body. It is perhaps not a mere coincidence that the frequency  $f \sim 10^3$  Hz which corresponds to a wavelength of order head size is critical frequency from the point of view of the neurophysiology of hearing, and that the duration of a single bit of the memetic codon is of the order of millisecond. That physical pain is not experienced during dreams would be due to the natural absence of the back-projections producing pain.
2. The hallucinations in which some objects of the perceptive field are either miniature sized or gigantic could be understood. The back-projection to the retinae would realize faithfully the unrealistic relative sizes of the imagined objects.
3. The phenomenon of phantom leg could be understood if the mirror mechanism of long term memories is accepted. Phantom leg would in the geometric past and the pain would be remembered pain or rather, sharing of the pain experienced in the geometric past subjectively now. Phantom leg could be also genuine in the sense that it could consist of magnetic flux tube structures and MEs which remain when the biological organization at the atomic space-time sheet is destroyed.
4. How do I know that nerve pulse activity represents something outside my material body and not inside it? How do I know that the sound I hear does not originate inside my head? If the basic sensations are created already at the level of sensory organs, the boundary between internal and external worlds, it is easier to understand why we can make this distinction. If one accepts the possibility of entanglement of the sensory organs with the objects of the perceptive field, it is even easier to understand why we are

able to tell that the sound originates from the external world. This would also help to deduce the distances and sizes of the objects of the perceptive field.

5. This general view generalizes also to the motor actions. In some sense, motor imagination would be a motor action starting from some level above muscles and proceeding backwards in the geometric time. Thoughts as internal speech could be understood as a special case of this mechanism. Of course, the mechanism must involve both time directions and a more precise view about motor action as time reversal of memory recall, reducing at the limit of short time spans to sensory perception, will be discussed later.

Of course, one can invent objections against sensory magnetic canvas hypothesis and the hypothesis that primary sensory qualia are seated at the level of sensory organs.

1. Microwave hearing is a phenomenon in which microwaves generate a sensation of hearing [42]. There are several reasons to believe that the primary stimulus does not enter the ears but cortex [N1]. The hypothesis that sensory organs are the seats of the sensory qualia can be saved only if a back-projection from cortex to ears is involved. Microwave MEs would be able to generate something analogous to electrical stimulation of auditory areas. Note that back-projections to ears can generate oto-acoustic sounds heard even by outsiders. The auditory back projections could be realized also in terms of membrane oscillations. The back projection to eyes could also involve em MEs at visible frequencies.
2. If odors and tastes reduce to the binding of the chemicals to the sensory receptors, it is difficult to imagine that back-projection mechanism could produce odor hallucinations. Hence either long term sensory memories or, less probably, sharing of mental images by quantum entanglement should be in question. One can of course question the hypothesis that odor qualia require the chemical binding: there is evidence [43] that the odor perception of insects is analogous to infrared vision, seeing the infrared light generated by the odorant molecules [K3]. Moreover, olfactory receptors resemble visual receptors. If so, then odor sensations might be produced also by back-projection mechanism using IR MEs. Also hallucinated pain could be used as an objection since it is difficult to imagine why evolution would or could have produced a back-projection for the pain sensation. Long term memories as in the case of phantom pain could be however in question.
3. Is the sensory magnetic canvas really needed for sensory representations? Could the magnetic bodies associated with sensory organs be enough so that our magnetic body would be like a trees with roots identifiable as magnetic bodies of the sensory organs and carrying the fundamental sensory representations. Higher level symbolic and cognitive representations

corresponding to the branches of the tree yielded by cortex would entangle with the sensory world represented by the roots. Brain would be really analyzer not the builder of sensory experience in this view.

The requirement that long term memories are there, forces the introduction of the personal magnetic body with astrophysical size. It would be also in a conflict with fractality to exclude the entanglement in the length scale of the personal magnetic body if it is allowed in shorter length scales. This objection however forces to take seriously the possibility that the representations at the personal/cortical magnetic body are very abstract, and that the topographical mapping of the perceptive field to the personal magnetic body is un-necessary. One possibility is that the personal magnetic body is specialized to geometric memories with the length of magnetic flux tube defining the time span of the memory quite generally. In fact, the experimental findings of Libet force to conclude that sensory perception is a particular case of geometric memory.

4. This line of view forces to consider the possibility that seeing the object of the visual field is a more active process than we are accustomed to think. Could MEs emanate from eyes and form join along boundaries bonds with the object of the visual field so that seeing would be in certain sense like tactile sensing, touching by MEs, somewhat like the bats hear? The cartoon pictures in which rays emanate from eyes would contain a seed of truth. In the case of hearing the MEs could play a role of radar.

The scaling law of homeopathy [K5] states that high and low frequency MEs appear as pairs. The high frequency MEs representing visible light from the external world might arrive along ELF MEs to the eyes, and eyes could even send very weak "radar rays" along MEs and reflected from the objects of the visual field. In particular, the MEs serving as radar rays might allow to deduce information about the distances to the objects of the visual field. This hypothesis does not imply that the magnetic bodies associated with the eyes would be of the same size as the visual field: much larger size is suggested by the 80 Hz resonance frequency involved with the retinae. Note also that we are able to see ordinary 2-dimensional pictures as 3-dimensional, and perceive a 3-dimensional object in a 2-dimensional picture containing only a chaotic set of points (auto-stereogram). Therefore brain can construct three-dimensional sensory percepts also without the active interaction with the external world.

In fact, the vision about magnetic body as active perceiver using the time mirror mechanism with negative energy MEs time reflected from the biological body as positive energy MEs realizes the idea about sensory perception as an active radar like process. Now brain and body becomes the objects at which time reflection occurs. Something similar is expected to occur at the lower levels of the hierarchy.

## 2.4 Altered states of geometric consciousness

The proposed view about sensory representations could explain several mysterious looking phenomena related to tactile senses of which representative examples are described in [38]. Phantom leg and projected pain (say feeling heart pain in left arm) are standard examples. Remote tactile sensing is experienced every-day. For instance, car driver feels the wheels on the road. The projection to sensory canvas would explain this sensation but one could also consider the possibility that the car becomes a part of body by entanglement. One fascinating application of remote tactile sensing is based on vision based vibratory sense: TV picture is coded into skin vibrations and patient soon learns to see the world in this manner. People learn also to "see" by hearing. These phenomena cease to be strange when one realizes that geometric qualia accompany in principle all senses. The hypothesis that also the objects of external world are represented as sensory sub-selves (mental images) such that also the visual, auditory and tactile sensory fields become parts of self, explains remote tactile sensing.

Some personal altered states of tactile consciousness resembling hypnagogic state deserve to be mentioned here. The state involves strong illusion of being fully awake and about transition to a state in which body is felt to be in fluctuating wavelike state changing its shape freely. Also the experience about flying to the roof is often involved. Often I can see own body (as 'insider', OBE is not in question) and it is often deformed in bizarre manner. A possible interpretation is that in absence of the sensory input from external world, the values of the spatial coordinates associated with mind like sheets representing body parts in the somatosensory cortex vary widely from their normal values and that dreamer can change these values in certain limits at his will.

## 3 A model for sensory representations, long term memories, and motor actions

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

### 3.1 Magnetic body as the sensory canvas

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

1. Place coding by cyclotron frequency scale could easily wake-up mental images representing the positions of the objects of the perceptive field in the magnetic body. A more attractive manner to see the situation is to identify magnetic body as an active perceiver sending negative energy topological light rays time reflected at the biological body as positive energy topological light rays and providing information about its state much like the ordinary reflection of light provides information about the object of the perceptive field.
2. The distance of the point of the flux tube from the sensory organ could be coded to the thickness of the flux tube which in turn defines the cyclotron frequency. Most naturally, the strength of the field is the strength of the corresponding Maxwellian magnetic field and the density of the magnetic flux tubes is scaled accordingly from the requirement of the quantization of magnetic flux.
3. The radial EEG MEs assigned with the cortical axons in the TGD based model of EEG could serve as projectors having contacts with the magnetic flux tubes of the personal magnetic body. MEs would entangle cortical mental images and sensory mental images at sensory organs with the "simple feeling of existence" mental images at the points of the magnetic body. Note that the magnetic bodies of sensory organs could carry the fundamental sensory representations.
4. The EEG frequency and its harmonics associated with ME would induce magnetic quantum phase transitions at the magnetic canvas and wake-up mental image at a distance corresponding to the estimated distance of the object of the perceptive field but which need not be same. The association of visual colors with the points of the perceptive field would result from the retina-magnetic body entanglement. Auditory experience might involve a similar mapping but might use  $Z^0$  magnetic field as canvas. Also ears contain strong back-projections necessary for auditory dreams.
5. EEG MEs serving as projections to the magnetic canvas results in the cyclotron transitions at the magnetic flux tubes of endogenous magnetic field having strength  $\simeq .2$  Gauss (experiments of Blackman and others), which is  $2/5$  times the nominal value  $.5$  Gauss for the Earth's magnetic field. At the magnetic flux tubes of the personal magnetic canvas similar process occurs. The rate for the transitions should be maximized in both cases. At the magnetic body this is achieved if the super-conduction ion at the magnetic flux tube is first 'kicked' to a smaller space-time sheet wherefrom it 'drops' back to the magnetic flux tube, and because of its zero point kinetic energy enters into a high  $n$  cyclotron state, which in turn decays by emitting harmonics of the cyclotron frequency. The 'kicking' is achieved if the ELF ME responsible for the entanglement contain microwave MEs, which generate join along boundaries bonds connecting magnetic flux tube with smaller space-time sheets. This in turn leads to

the breaking of super-conductivity and primitive metabolic cycle in which ions flow to the atomic space-time sheets and back to the magnetic flux tube. This would mean that the microwave radiation from brain serves as the 'food' of the primitive plasmoid like life form representing the simple 'feeling of existence' mental image at the magnetic sensory canvas.

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

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

### 3.2 The mental images at the personal magnetic body

The sizes of the images of the objects of the cortical sensory representation located outside the body would not correspond to the real size of the objects of the perceptive field. The sizes of ELF ME are typically of order Earth size and this gives upper bound for the size of the representative objects. If brain itself generates the magnetic canvas then it might be natural to expect that the scaling factor involved is one but one must be very cautious in making any strong conclusions. The problem are that it is not at all clear how this scaling factor could be achieved and how it could be useful. Furthermore, the requirement that the magnetic field strength along the flux tube varies very slowly supports the view that the sub-selves at magnetic body ("simple feeling of existence") can have sizes of order ELF ME.

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

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

1. The personal magnetic body interacts with the external world, in particular, with the Earth's magnetic field and with the solar wind carried by

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

2. Solar wind might enclose part of the personal magnetic body inside the Earth's magnetosphere, whereas the interaction with the flux tubes of the Earth's magnetic field could force the flux tubes of the personal magnetic body to be more or less parallel to them. Incoherent summation of the personal and terrestrial magnetic fields, fractality, plus the fact that the field strengths associated with the flux tubes of the personal magnetic body should decrease much slower with the distance from Earth's surface than those of the Earth's magnetic field, are consistent the possibility that the flux tubes of the personal magnetic body with field strengths stronger than that of the Earth's magnetic field reside inside the magnetic flux tubes of the Earth's magnetic field in far-away regions. That part of the personal magnetic body which corresponds to field strengths weaker than the strength of the Earth's magnetic field could quite well have size measured in light years.
3. The highly self-organizing plasma sheet at the equatorial plane at the night side of the Earth's outer magnetosphere is an especially interesting structure as far as personal and magnetospheric sensory representations are considered. For the fractal option the plasma sheet of the Earth's magnetosphere would contain plasma sheets inside plasma sheets, in particular the plasma sheets associated with the personal magnetic bodies. Personal and magnetospheric sensory representations would correspond to different levels of the same fractal structure.
4. Also the intra-terrestrial part of the Earth's magnetosphere is important for the magnetospheric sensory representations and, if the fractality hypothesis holds true, also for the personal ones. The strange co-incidences of important cavity resonance frequencies of intra-terrestrial structures with EEG resonance frequencies, and the fractal correspondence between the architectures of brain and magnetosphere [N1] support the view that personal magnetic body extends also to the interior of Earth. The flux tubes of the Earth's magnetic field (with field strength increasing faster than for the flux tubes of the personal magnetic body) would be however contained *inside* those of the personal magnetic body in this region. The intra-terrestrial consciousness would therefore represent sub-...-selves of ours, something analogous to Id whereas magnetospheric sensory representations would correspond to the super ego. This interpretation conforms

with the proposal that intra-terrestrial life forms are possible in the many-sheeted space-time, and that crop circle formations could be interpreted as attempts of ITs to communicate about their existence [N2, N3].

5. Probably it makes sense to speak about  $Z^0$  magnetosphere (both solar and terrestrial).  $Z^0$  magnetic flux tube structures are crucial for the model of long term memories [H6], and the sizes of the flux tube structures associated with the personal  $Z^0$  magnetic body should be measured in light years. This suggests that also much weaker personal magnetic and  $Z^0$  magnetic fields with the lengths of the closed flux tubes measured in light years are relevant.

### **3.3 Cortex as a collection of attributes assigned to the objects of perceptive field represented at magnetic canvas**

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

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

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

entanglement of the feature with a particular part of, say, primary sensory area representing a point of the perceptive sphere.

3. The direction of the point of the perceptive field could be coded basically by the direction of the magnetic flux tube emerging from the particular position of the sensory area providing map for solid angles of the perceptive field. The mechanism would be based on resonance with Alfvén waves associated with the magnetic flux tubes of personal magnetic body amplifying MEs in the direction of magnetic flux tubes. The length (fundamental frequency) of ME would code for the distance of the point of the perceptive field to the distance of the point of the sensory magnetic canvas. Frequency coding could be achieved by varying the local value of the magnetic field responsible for generating the cyclotron frequency. This coding could be either dynamical or static in which case distance could be most naturally coded to linear structures, most naturally in direction orthogonal to the cortical surface.
4. Features would be basically associated with sensory organs, various neural pathways and brain areas and coded partially by nerve pulse patterns. Features could be practically all kinds of sub-selves generated by brain activity. Primary qualia could be realized at the level of sensory receptors if entire sensory pathways entangle with the magnetic body. It seems that the identification of sensory organs as seats of sensory qualia is the most, and perhaps the only, plausible option in TGD framework.
5. Projector MEs would be orthogonal to the sensory area where they emanate. The topographic mapping of the perceptive field to the sensory areas would guarantee that sensory images would remain stationary under rotations of head: although sensory magnetic sensory canvas would move the image projected to it would be stationary. MEs and magnetic flux tubes must be parallel if Alfvén wave resonance is involved. In this manner the experiences could remain private and the contribution from the other brains would remain negligible. Note however that people in very intimate contact could gradually share their magnetic sensory canvases: the anecdotes about gradually developing telepathic communications between the teachers and students of the meditative practices could involve this kind of sharing of computer screen between several users.
6. In this coding EEG MES would entangle with essentially all symbolic information about the perceptive field and the spectroscopy of consciousness would be realized in a strong sense.

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

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

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

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

### 3.4 Place coding

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

are mapped to the personal magnetic body in a topographical manner.

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

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

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

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

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

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

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

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

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

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

visual consciousness could be induced. For heavy ions, isotopic degeneracy would lead to large number of alternative modes of ionic consciousness and this might give rise to enhanced cognitive abilities.

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

### 3.5 Magnetospheric sensory representations

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

The location of the magnetospheric representations could be stationary with respect to the inner magnetosphere. This would require that the MEs projecting the information to the magnetosphere emanate from the head in a direction which is fixed with respect to the local direction of the magnetic field of Earth (the MEs associated with the personal magnetic body would project in a direction orthogonal to the surface of cortex). Most naturally this direction would be the direction of the local magnetic field since this makes possible amplification based on Alfvén wave resonance. Stationarity of the directions of MEs projecting to the magnetosphere could be achieved by the interaction of the magnetic dipoles with Earth's magnetic field forcing the directions of the magnetic dipoles to the direction of Earth's magnetic field and thus making brain a compass. Brain is indeed full of magnetic materials, human brain is a compass and humans have magnetic navigation sense.

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

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

magnetic field. This in turn could cheat the  $Z^0$  compass. This indeed happens. When the spinning stops, sensation of dizziness results and the world is experienced to spin.

### 3.6 Remote mental interactions and sensory magnetic canvas hypothesis

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

There is some evidence for the possibility of a interaction between minds via projected sensory representations. Some dogs are able to anticipate the epileptic attacks of their master and are systematically trained for this purpose. Some dogs have an amazing skill to precognize that their master is coming home: ordinary sensory perception such as olfaction is excluded as an explanation. The practitioners of transcendental meditation claim that collective meditation can have a definite positive effect on conflict situations occurring at the other side of the world proportional to the square of the number of participants (coherence). The vision of Sheldrake [19] about morphogenetic fields making possible the claimed learning at the level of species could be modelled concretely in terms of this interaction.

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

It is known that the statistics about mental states of patients of mental hospitals demonstrates strong correlation with magnetic storms induced by sunspots. The magnetic perturbations induced by lightnings known as sferics are known to have a direct effect on EEG and brain functioning [44]. Tectonic activity, such as Earth quakes, can induce various kinds of hallucinations such as encounters with UFOs and religious experiences [45] perhaps involving sharing of mental images. Animals are even able to anticipate earth quakes. When the car ferry Estonia suffered a shipwreck for few years ago taking with it almost thousand people into the depths, hundreds of people reported they had experienced a nightmare obviously relating to this event. Sharing of mental images

or sensory percepts produced by back-projection from symbolic representations created by or communicated to brain could be in question.

The known general features of remote mental interactions support the view that magnetospheric multi-brained selves serve as a kind of relay station or medium allowing the remote mental viewer to entangle with the target. Remote viewer would essentially see with the eyes of this higher level self [H9, K4].

### 3.7 Mirror mechanism of geometric memories

The mirror mechanism of long term memories involves several purely TGD based features [H6].

1. The classical non-determinism making possible time-like quantum entanglement and sharing of mental images.
2. Space-time sheets with a negative time orientation allowing classical signals associated with negative energy MEs to propagate backwards in time and making possible entanglement.
3. The identification of the personal magnetic body as the experiencing intentional agent sending negative energy MEs parallel to the magnetic flux tubes to the brain acting as the time mirror. This option, forcing to take completely seriously the notion of the magnetic body, provides the most elegant identification of the time mirror discovered hitherto. If brain is identified as the sender of the negative energy MEs, the identification of the mirror and correct timing of pose problems. One possibility is that the closed flux loops associated with the personal magnetic and  $Z^0$  magnetic bodies having sizes of order light years making it possible for negative energy MEs to repeatedly reflect along them and return back to the brain of the geometric past.
4. The possibility of MEs and magnetic flux tubes interacting weakly with the ordinary matter but strongly with living matter in cell length scales.

#### 3.7.1 Mirror mechanism

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

For the time-mirror model of long term memory the ULF dark MEs must be generated both at the personal magnetic body and in the brain.

1. At the personal magnetic body cyclotron phase transition would give rise to negative energy neutral MEs sucking energy from the biological body of the geometric past. This radiation would be reflected back to the geometric future as positive energy neutral MEs. The response would depend on the state of the brain. Motor action would differ from memory recall only in that it would involve negative energy  $W$  MEs inducing exotic ionization at both ends and leading to a physiological outcome. The entanglement via  $W$  MEs could induce direct sensory memories relying on sharing and fusion of mental images.
2. The ULF radiation representing the response to the memory recall would correspond to Josephson radiation giving rise to a scaled up dark EEG in the relevant time scale characterized by the level of the dark matter hierarchy. The size of Josephson junctions assignable to cells and cell structures would be scaled up from cell membrane thickness by a power  $\lambda^k$ ,  $\lambda \simeq 12^{11}$  at the  $k^{th}$  level of the dark matter hierarchy and magnetic flux quanta would define the Josephson junctions naturally [M3]. The de-coherence of higher level dark photons to single ordinary EEG dark photon or their decay to EEG dark photons is probably involved with the memory call and would transform the response from the geometric past to ordinary cognitive and emotional input at personal magnetic body.

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

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

This represents a frequency coding for the temporal location. In standard physics the idea about brain generating MEs with a frequency scale of the order of the inverse of lifetime does not make sense: in TGD context situation is different since this process occurs in subjective time. By the arguments discussed in more detail below, positive energy neutral MEs are ideal for communication of long term memories to the geometric future. The concrete mechanism for the generation of MEs as associated with transitions between almost degenerate configurations of spin glass with slightly different classical gravitational energies is discussed in [H6].

### 3.7.2 More detailed model for long term memories

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

1. Spontaneous episodal memories would be based on negative energy MEs entangling the geometric now with the geometric past and making possible sharing of mental images. In particular, sensory memories would rely on

this mechanism. This mechanism could also make possible only the communication of the desire to remember to the geometric past in the case of an active memory recall and non-episodal memories. One can however wonder what distinguishes the resulting experience from precognition by the self of the geometric past: could it be that to precognize now is to remember in the geometric future? The fact that MEs represent channelled energy means that distance is not a problem as far as energetics is considered.

2. In the case of non-episodal memories the information could be communicated classically from the geometric past as 'bits' and be coded into the light like vacuum current associated with ME. If the magnetic body is the "me", positive energy MEs could simply travel along the same magnetic flux tube along which the negative energy ME arrived. Magnetic flux tube would act as a wave guide amplifying ME by Alfven resonance.
3. Neural MEs with negative energies are especially favored for quantum communications. The reasons are many-fold. The interaction with the matter is very weak in long length scales but strong in cellular length scales, negative energy implies that ME is identifiable as a virtual particle and analogous to a part of a Feynman diagram so that no dissipation is involved and quantum communication is possible. The reversal of the arrow of geometric time means also that there is not macroscopic dissipative dynamics which would spoil the quantum coherence.
4. The requirement that the receival process is highly selective suggests a resonance mechanism. This requires that the fundamental frequencies associated with MEs are somehow universal. p-Adic length scale hypothesis indeed predicts hierarchies of universal frequencies. A stronger requirement is that the receiving and sending structures are somehow similar, and many-sheeted space-time allows to realize this kind of option. Negative energy ME cannot be emitted unless there is a receiver absorbing the negative energy and in this manner providing energy for the sender by buy now-let others pay mechanism. The time mirrored positive energy ME can even amplify the reflected negative energy signal by stimulated transition to the ground state if the receiver is a many-sheeted analog of a population inverted laser.
5. Negative energy MEs represent time reversed level of the p-adic length scale hierarchy so that the dissipative effects associated with the space-time sheets with the normal arrow of time should not interfere with the quantum communication. This at least, when the energy of the negative energy ME has a magnitude larger than the thermal energy associated with the space-time sheets with which it interacts: there is simply no system which could make a transition to a lower energy state by the absorption of a negative energy ME. Furthermore, since systems with reversed arrow of geometric time are expected to have extremely low density, the dissipative

effects in the reversed direction of time are expected to be small. Since the generation of negative energy MEs does not require energy feed, the memory recall to the geometric past occurs more or less spontaneously, and the scanning of the geometric past becomes possible. In the case of precognition precognizer must intentionally receive negative energy MEs from the geometric future so that energy feed is needed. This perhaps explains why precognition is so rare. Note that p-adic variant of precognition having interpretation as intentionality occurs easily since p-adic energy is conserved only in piecewise manner.

If this picture has captured something essential from the nature of the long term memories, the conclusion is that we are not at the top of the magnetic sensory hierarchy. Human body and brain generates extremely weak magnetic fields and the corresponding magnetic flux tube structures could make possible long term memories. Near death experiences [I3] could be understood in this framework if the weak magnetic fields associated with the higher levels of the fractal hierarchy of magnetic structures utilize brain and body as kind of sensory and motor organs. Note that there is a flux tubes inside flux tubes structure so that ordinary sensory experiences can be associated also with these flux tubes.

### **3.8 Sensory perception, motor action, and time**

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

#### **3.8.1 Sensory organs as seats of qualia**

According to the music metaphor, sensory organs are responsible for the music whereas brain writes it into notes by building symbolic and cognitive representations communicated to the magnetic body. Back projection to the sensory organs is an essential aspect of this process and is discussed in [K3]. 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 [K3]. One can also consider the possibility that sensory organs and their magnetic bodies define the sensory capacitors whose discharges give rise to sensory qualia and that these magnetic bodies give also rise to low level cognitive and emotional representations.

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

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

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

### **3.8.2 How motor action differs from sensory perception?**

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

and brain are possible.

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

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

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

Libet has carried out classical experiments about active and passive aspects of consciousness [20, 21]. 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 [20, 22] 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 [22].  $T_1$  is very near to the p-adic time scale  $T(6, 43) = .4$  seconds and  $T_2$  to the fundamental p-adic time scale  $T(2, 127)$  defining the duration of the memetic codon.

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

#### 1. *The geometric past changes in quantum jump*

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

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

2. The space-time surfaces (resulting as the final state of quantum jump) associated with the new quantum history differ in a detectable manner from the old quantum history already before the moment of hand movement since otherwise the new space-time surface would contain an instantaneous and discontinuous jump from the initial to final body configuration, which is not allowed by field equations. Same argument applies to the state of brain.  $\Delta T \sim .5$  seconds seems to be the relevant time scale.
3. The attempt of the experimenter to be objective means that in an ideal experiment the observations correspond to the new deterministic history in the associated quantum jump and hence experimenter sees neurophysiological processes as the (apparent) cause of the hand movement with respect to geometric time. With respect to the subjective time the cause of the hand movement is the decision of the subject person.

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

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

This view about motor action means that it proceeds from long length scales to short ones whereas in the standard neuroscience view motor motor action would be planned and initiated in the brain and proceed to the level of motor organs, from short to long length scales. This certainly seems to be the case if one looks only the classical communications (say nerve pulse patterns). The extreme coherence of and synchrony of motor activities is however in conflict with this picture: neuronal communications are simply too slow to achieve the synchrony. This has been emphasized by Mae-Wan Ho [18]. 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.

#### **3.8.4 Strange time delays of consciousness: experiments related to the passive role of consciousness**

Libet's experiments [21] about the strange time delays related to the passive aspects of consciousness have served as a continual source of inspiration and headache. Every time I read again about these experiments, I feel equally confused and must start explanations from scratch.

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

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

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

#### *1. Communications from brain to magnetic body*

One must consider two kinds of communications from body to magnetic body corresponding to positive energy MEs generated by at least brain and negative energy ME sent by magnetic body to at least sensory organs. The assumptions are following.

1. Negative energy MEs bound state entangle the magnetic body with the sensory representations realized at the level of sensory organs, and constructed using back projection from brain and possibly also from higher levels. Fusion and sharing sensory mental images is involved. Also the classical communication of memories to magnetic body could be involved with the build up of sensory and symbolic representations at the magnetic body. In both cases sensory representations are memories with the same time lapse determined by the length of the MEs involved, a fraction of second typically if the magnetic body is of an astrophysical size. During sensory and motor imagination magnetic body entangles by negative energy MEs with some higher level of CNS.
2. Symbolic representations in brain can entangle with the sensory representations entangling in turn with the magnetic body so that CNS defines tree like structure with roots corresponding to sensory organs and branches and leaves corresponding to the higher levels of CNS. Direction of attention selects some path along this tree somewhat analogous to the path defining computer file in some subdirectory.

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

## *2. Libet's findings*

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

1. With respect to the psychological time of the external observer subject person becomes conscious about the electric stimulation of skin in  $\sim .5$  seconds.
2. 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.
3. One can combine an electric stimulation of skin with the stimulation of the cortex. The electric stimulation of the cortex requires a duration longer than .5 seconds to become conscious. 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 back projection then one could understand the change of the time ordering as resulting from .5 second lapse for the generation of back projection.

4. 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.

1. 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.
2. The stimulation of the cortex lasting at least .5 seconds would generate a back projection to sensory organs. The minimal duration of .5 seconds for the cortical stimulation would seem rather natural in order to avoid back projections 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.
3. 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 back projection 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.

## 4 First attempts to relate sensory canvas idea to neuroscience

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

There seems to be a general consistency of predictions of sensory canvas hypothesis with what is known about EEG. Mention only the evolution of EEG as the emergence of decreasing EEG frequency scales; the disappearance of alpha, beta and gamma bands from EEG during sleep; the existence of narrow coherent EEG sub-bands in all EEG bands; and also the complex fractal like coherency structures of EEG difficult to understand if EEG has a purely neural origin.

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

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

The considerations below rely on various review articles [23, 24, 25] about the recent situation concerning the understanding of EEG. Also the article [26] about neural correlates of consciousness, and the article [27] suggesting that primary sensory area V1 is crucial for conscious vision have been very useful in attempt to develop more concrete views about how sensory representations are constructed. I do not hesitate to admit that the model to be discussed is nothing more than a first attempt to relate the general idea of sensory canvas to the complex neuro reality and is severely restricted by my very limited knowledge about neuroscience (I am grateful for Gene Johnson for his patience while trying to teach me some basic facts about conscious brain).

### 4.1 Anatomical structure of the cortex and sensory canvas hypothesis

The anatomical structure and evolution of cortex inspires definite hypothesis about how brain constructs and realizes sensory representations at magnetic

sensory canvas and how magnetic sensory canvas builds up motor actions. In order to avoid confusions I want to stress that sensory representations generated by brain are assumed to be symbolic representations assigning meaning to the raw sensory input and do not involve qualia, which in TGD Universe are most naturally assignable to the sensory organs.

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

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

1. Computer metaphor encourages to consider the hypothesis that sensory representations and motor outputs have essentially the same character just like printout and monitor picture are different outputs of a same file in the case of a computer. First (with respect to the subjective time!) a rough sensory sketch is generated and then more and more details are added and the primary areas activate the final sensory representation just as in the case of motor output. As in the case of motor actions, higher levels of cortex simply select the activated sensory representation to be experienced consciously by us (binocular rivalry). The sequence of quantum entanglements proceeding from the magnetic body down to the magnetic bodies of sensory organs selects what is experienced consciously by us. There is probably a hierarchy of experiencers each characterized by particular selections.
2. The intention for motor activity is realized as p-adic MEs connecting magnetic body by entanglement sequence to motor organs and induces directly action at this level (buy now-let others pay principle and precise targeted realization of intention). This quantum communication like aspect is accompanied by classical communications from magnetic body to cortex and in terms of nerve pulse patterns from cortex to lower levels. Intention can be also initiated at higher level than motor organs and in this case motor imagination is in question.
3. Mental images are entangled with the mediation of the negative energy projector MEs along along magnetic flux tubes connecting magnetic bodies together. Hierarchical sequences of mental images result in this manner, and sensory qualia become associated with various higher level mental images. MEs can be thought of as representing radiation propagating in the wave channel represented by the magnetic flux tube and being reflected repeatedly. MEs need not be only simple cylindrical prototype MEs but can be also curved: this means that the number of reflections need not be

too high. Magnetic flux tubes are essentially guides for MEs so that they do not "lose their way".

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

#### **4.1.2 Neural correlates of visual consciousness and motor-sensory analogy**

The study of the neural correlates of visual consciousness reviewed in [26] allows to study the reasonability of the primary sensory areas as gateway to sensory canvas hypothesis and its variants.

1. Evolutionary argument suggests that both primary sensory organs and various sensory areas are accompanied by magnetic bodies providing increasingly abstract symbolic and cognitive representations for the sensory input. The neurons at the higher sensory areas indeed become increasingly complex and have increasingly wider receptive fields. In particular, in the case of vision the neuronal receptive fields at V4 and higher areas are also dynamical and determined by the attentional level. Color/orientation information and the information about motion are treated separately in parvo and magno cellular pathways in V1, V2 and V3 but not in V4 (for the organization of the visual pathways see [28]). These observations encourage the view that sensory areas define a hierarchy of separate magnetic bodies giving rise to more and more integrated conscious higher level representations of the sensory input. These representations define hierarchy of selves using the same brain and body.
2. The standard assumption about feed-forward hierarchy of the sensory areas leads to difficulties. For instance, in binocular rivalry of two competing visual stimuli feed to right and left eye, only the other stimulus is experienced at time. V1 and also V2 and V3 however contain neural representations of both stimuli. It has been also found that during the binocular rivalry the co-varying neural activities (seen by fMRI) in the extrastriatal visual cortex and in prefrontal cortex correlate with the subjective percept (rather than real stimulus) unlike the activity in V1 which represents both stimuli [29]. The manner to understand this is that quantum entangle-

ment sequences starting from the magnetic body proceed down to sensory organs and select from V1, V2 and V3 only the second stimulus.

3. It is known that neural activity in parietal and frontal regions is involved with the change of the dominating stimulus and that the activity in visual areas is not enough for visual consciousness [26]. Thus the presence of neural representations of both stimuli in V1 but conscious experience of only one stimulus would support the view that neuronal activity is *not* enough to generate our conscious experience. If the hierarchy of entanglements proceeds from our magnetic body to frontal lobes and from there downwards it is easy to understand why the activity in frontal lobes is essential for selecting the consciously experienced stimulus. Obviously the sensory-motor loop would have counterpart in much longer length scales.
4. V1 seems to be necessary for visual consciousness. Pascual-Leone and Walsh have studied the visual hallucinations induced by transcranial magnetic stimulation [30]. The stimulation of V1 generates static and colored impressions whereas the stimulation of V5/MT generates moving non-colored phosphenes (in accordance with the fact that 'where' type information processing is color blind and 'what type' information processing at lowest levels is motion blind). This picture is consistent with the idea that the fundamental visual representations are realized at retinal magnetic bodies. The back-projections in question would be essential for the "qualiafication" of imagination during dreams and hallucinations.
5. The study also demonstrates that the stimulation of V1 *after*, rather than before, the stimulation of regions V5/MT sending feedback to V1 can prevent the generation of hallucination. Even more, [27] describes a case in which patient has lost visual consciousness when V1 is not intact. There is indeed a strong neural feedback to V1, V2 and V3 from the higher visual areas V5/MT and area V1 is activated simultaneously with MT in macaque. These findings are in conflict with what one might expect if sensory processing proceeds in strictly feed-forward manner. The necessity of V1 for our visual consciousness is obvious if entanglement sequences go through V1 down to the level of retinas. Feedback would also make possible "coloring" of the sensory map during ordinary wave-up experience. Perception would be creative act already at the level of sensory organs.
6. The timing of the interactions in the visual areas provides further hints about how sensory representations are constructed. According to [27] that early activation of V1 by magnocellular neurons in LGN occurs 20 ms earlier than the activation by parvocellular neurons. At this time also the feedback from V5/MT arrives to V1. This suggests that sensory map is constructed by making first a rough sketch using the sensory input from the magnocellular pathways (motion and position). For about 20 milliseconds later follows the coloring of the sensory map as well as the association of the higher level features to the map. This order is consistent with

the fact that highly developed parvocellular pathway is a newcomer in the evolution and that the information involved is not so vital for survival. Thus V1 would act as an effective 'active blackboard' as has been suggested [27] and by the sensory-motor analogy in TGD framework.

## 4.2 EEG and sensory canvas hypothesis

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

### 4.2.1 Why the endogenous magnetic field corresponds to .2 Gauss?

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

Dark matter hierarchy leads to a detailed quantitative view about quantum biology with several testable predictions [M3]. The applications to living matter suggests that the basic hierarchy corresponds to a hierarchy of Planck constants coming as  $\hbar(k) = \lambda^k(p)\hbar_0$ ,  $\lambda \simeq 2^{11}$  for  $p = 2^{127-1}$ ,  $k = 0, 1, 2, \dots$  [M3]. Also integer valued sub-harmonics and integer valued sub-harmonics of  $\lambda$  might be possible. Each p-adic length scale corresponds to this kind of hierarchy. Number theoretical arguments suggest a general formula for the allowed values of  $\lambda$  [C7] as  $\lambda = n$  where  $n$  characterizes the quantum phase  $q = \exp(i\pi/n)$  characterizing Jones inclusion [C6]. The values of  $n$  for which quantum phase is expressible using only iterated square root operation are number theoretically preferred and correspond to integers  $n$  expressible as  $n = 2^k \prod_n F_{s_n}$ , where  $F_s = 2^{2^s} + 1$  is Fermat prime and each of them can appear only once.  $n = 2^{11}$  obviously satisfies this condition. The lowest Fermat primes are  $F_0 = 3, F_1 = 5, F_2 = 17$ . The prediction is that also n-multiples of p-adic length scales are possible as preferred length scales. The unit of magnetic flux scales up as  $h_0 \rightarrow h = nh_0$  in the transition increasing Planck constant: this is achieved by scalings  $L(k) \rightarrow nL(k)$  and  $B \rightarrow B/n$ .

$B = .2$  Gauss would corresponds to a flux tube radius  $L = \sqrt{5/2} \times L(169) \simeq 1.58L(169)$ , which does not correspond to any p-adic length scale as such.  $k = 168 = 2^3 \times 3 \times 7$  with  $n = 5$  would predict the field strength correctly as  $B_{end} = 2B_E/5$  and predict the radius of the flux tube to be  $r = 18 \mu\text{m}$ , size of a large neuron. However,  $k = 169$  with flux  $2h_5$  would be must more attractive option since it would give a direct connection with the Earth's magnetic field.

Furthermore, the model for EEG forces to assume that also a field  $B_{end}/2$  must be assumed and this gives the minimal flux  $h_5$ . Note that  $n = 5$  is the minimal value of  $n$  making possible universal topological quantum computation with Beraha number  $B_n = 4\cos^2(\pi/n)$  equal to Golden Mean [E9].

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

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

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

Dark matter hierarchy correspond to a hierarchy of values of Planck constant coming as  $\hbar = \lambda^k \hbar_0$ ,  $k = 0, 1, 2, \dots$ .  $\lambda \simeq 2^{11}$  is integer and its harmonics and sub-harmonics cannot be excluded. The model for the hierarchy of generalized EEGs assigns to each level of dark matter hierarchy a typical time scale identifiable as typical time span of memories. From this one can conclude that  $k = 7$  is the highest level contributing at personal levels of conscious experience.  $k = 4$  assignable to ordinary EEG corresponds to the time scale determined by EEG frequency scale. In this case the hypothesis about evolution proceeding as the emergence of higher and higher levels of dark matter hierarchy at the level of personal consciousness is very natural.

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

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

##### 1. Cerebellar, retinal, and cortical rhythms

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

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

If  $k_{em} = 4$  dark matter level is assumed to be in question and if one assumes that 200 Hz rhythm is analogous to sensorimotor rhythm of 13 Hz

( $\text{Na}^+$  cyclotron frequency) then scaling then the magnetic field at the field quanta involved should be  $\simeq 16$  times stronger than  $B_{end}$ . Since  $B_{end}$  most naturally corresponds to the p-adic length scale  $k = 169$  and magnetic flux  $2h_5$ , this field could correspond to  $k = 169 - 8 = 161 = 7 \times 23$  (scaling down of thickness of flux sheets flux sheets) or  $k = 169 - 4 = 165 = 5 \times 53$  (scaling down of the radius of the flux tube). The work of Gariaev [49] provides support for the hierarchy of magnetic flux sheets of various thicknesses associated with chromosomes and favors  $k = 161$  option.

2. The micro-tremor of retina corresponds to 80 Hz frequency and would relate naturally to 40 Hz thalamocortical resonance frequency if the magnetic field in question corresponds to transversally scaled down magnetic flux sheets having  $k = 167$  instead of  $k = 169$ . Note that  $k = 167$  corresponds to the Gaussian Mersenne  $(1 + i)^{167} - 1$ .
3. Primary sensory areas are dominated by 40 Hz frequency. Lowest frequencies such as hippocampal theta are in turn associated with long term memory which corresponds to high level mental function distinguishing sharply between humans and other species.

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

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

The spin flip frequencies in EEG range (see the table 4) are  $f_s(\text{Cl}) = 82$  Hz and  $f_s(\text{Rb}) = 81$  Hz (80 Hz micro-tremor in retina);  $f_s(\text{K}) = 39$  Hz and  $f_s(\text{Y}) = 41$  Hz (both very near to 40 Hz thalamocortical resonance frequency);  $f_s(\text{Ag}) = 34.2$  Hz,  $f_s(\text{Rh}) = 26.6$  Hz (27 Hz resonance frequency in dog's cortex);  $f_s(\text{Ir}) = 17$  Hz (narrow band in EEG [23]),  $f_s(\text{Au}) = 14$  Hz (the sleeping spindle frequency).

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

3. *p-Adic length scale hierarchy as abstraction hierarchy*

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

involved with long term memory recall are expected to correspond to the time span of the memory characterized by the level of the dark matter hierarchy.

#### 4. *Objection against p-adic evolutionary hierarchy*

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

1. According to [31], the wake-up EEG of infants before 3 months age consists of 'fast' background activity. At three months posterior delta rhythm appears at 3-4 Hz and gradually shifts to 6-7 Hz during the first life year. According to [32], binding related 40 Hz oscillations are evident at the age of 8 months. Also the contrast sensitivity of vision improves rapidly to adult level at this age: this conforms with the hypothesis that EEG is essential for the construction of the sensory representations.
2. According to [33], for infants the counterpart of the alpha band appearing in darkness is the occipital rhythmic activity in the range 5.2 – 9.6 Hz with peak frequency at about 7 Hz and increases gradually. The frequency band 6.0 – 8.8 Hz with gradually increasing peak frequency at about 7 Hz is activated during visual attention and seems to be the counterpart of sensory-motor rhythm of about 13 Hz of adults. It would be interesting to know whether the sensorimotor rhythm is eventually established via a continuous shift of this band or not.

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

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

The work of Jaynes inspires the idea about child as a small bicameral nursed by the higher collective levels of consciousness. The location of the sensory motor and alpha rhythms in theta band could indeed be seen as an indication for a kind of magnetic nursery provided higher level magnetic selves and their presence would not corresponds to the infant's consciousness but to the consciousness of the "magnetic nurse". Rather interestingly, according to Jaynes [34] sitting in mother's lap can induce EEG in infants not possessing stable EEG yet. An interesting question is whether mother's EEG shows a correlation with that of infant and whether it deviates from ordinary EEG in theta band.

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

#### 4.2.4 EEG rhythms in contrast to evoked and event related potentials

Evoked and event related potentials are believed to be associated with the neuronal activities generated by the sensory stimuli and it seems that they must be distinguished from the narrow frequency bands associated with the sensory and cognitive representations. Indeed, both evoked potentials associated with simple stimuli and event related potentials accompanying more complex stimuli have temporal structure which clearly reflects the propagation of nerve pulses along various parts of brain and one can assign to the peaks of the evoked potentials various anatomical correlates in the neural pathways involved [35].

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

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

#### 4.2.5 Coherence of EEG and sensory canvas hypothesis

If the EEG measured at skull relates closely to the sensory representations, it must inherit high coherence from the high coherence of the sensory landscape. Also fractal like hierarchy is predicted. At higher frequencies associated with sensory representations in shorter length scales, coherence should be restricted

in shorter range. Indeed, according to [23], the coherence length for EEG at skull is present and measured by using 10 cm as a natural unit. This coherence could reflect the correlations between neural activities in various parts of brain but it is not at all obvious whether the timing of neural ionic currents can be so sharp that destructive interference cancelling the correlations EEG level does not occur.

According to [23], very complex structures of coherence in bands around 3, 5 and 7 Hz and 13, 15 and 17 Hz are definitely inconsistent with simple dipole models for the generation of EEG patterns. The findings are however consistent with the view that several distant regions of cortex can project features to the same point of a sensory map and that the coherence reflects the coherence of the sensory map. Coherence regions could naturally correspond to the objects of the perceptive field. The high coherence in the band 4 – 5 Hz during mental calculations [23], which certainly represent abstract information processing and involve also long term memory in an essential manner, supports the view that abstract long term memories correspond to lowest EEG bands at 3, 5 and 7 Hz. According to [23], also increase of coherence between prefrontal and posterior cortical association areas have been reported during working memory retention in the range 4 – 7 Hz.

The coherence lengths for EEG inside cortex are generally much shorter and complex patterns are encountered. Coherence length of order 2 cm is associated with cortical EEG structures which Freeman introduces as basic units of EEG activity [24] and calls mesoscopic level of sensory processing. Note that also retina has same size as the mesoscopic structures. Perhaps it is not accident that this length scale corresponds to the highest ionic cyclotron frequencies in Helium period.

#### **4.2.6 EEG synchrony**

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

On the other hand, when the conscious percept was transformed from a random set of points to a coherent gestalt, there was a detectable increase in 40 Hz power in the occipital and right posterior sites for EEG electrodes in a time window 500-300 ms before the unified percept was reported. No increase of power in beta bands was detected: this might be due to the fact that the widths of the measured bands are much wider than the widths of the narrow

sub-bands reported masked by other EEG activity according to [23]. Note that in the model for a hierarchy of EEGs based on dark matter hierarchy beta band correspond to data communicated to the magnetic body [M3].

That the change in activity is associated with the emergence of a new percept suggests that the temporary increase of the EEG power could be assigned to the reaction of the magnetic body to the symbolic mental image in the cortex representing the new percept.

If the response is realized as a negative energy signal from the magnetic body to the geometric past, the time lapse due to the propagation of the sensory signal to the magnetic body is compensated since the negative energy signal travels to the geometric past. In this case the time lapse of 300-500 ms would correspond to the time it takes for the cyclotron phase transition at the magnetic body to occur so that the time lapse would not provide estimate for the distance to the magnetic body. The frequency scale of 40 Hz would suggest that the length scale involved is about  $.75 \times 10^7$  m whereas 3 ms lapse would imply a length scale of  $.5 \times 10^8$  meters if only positive energy signals are involved.

There could be also some time lapse between the unified percept and the report about it but it is not clear whether this can explain the entire lapse. That the change occurred 300-500 ms before the report about the emergence of a unified conscious percept is consistent with the view that the conscious percept is possible only after the new sensory representation at the sensory magnetic canvas has been established. This lapse is not predicted if only brain is involved so that the observing self would be indeed the magnetic self rather than brain.

#### 4.2.7 Narrow EEG bands and sensory canvas hypothesis

Sensory canvas hypothesis predicts the existence of narrow EEG bands corresponding to the magnetic transition frequencies varying in the range determined by the thickness range for the magnetic flux tubes involved with the sensory representation. The most natural candidates for the magnetic transition frequencies are cyclotron frequencies and their harmonics. There is indeed evidence for this kind of bands [23].

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

2. Besides alpha band Nunez mentions also narrow sub-bands at 3, 5 and 7 Hz at delta and theta range, as well as sub-bands at 13, 15 and 17 Hz in beta band [23]. That beta disappears when eyes are closed conforms with the interpretation of these bands as being associated with sensory communications to the magnetic body. Hence these bands might be associated with the assignment of cognitive features to the points of the sensory canvas. Indeed, the evolutionary hierarchy sensory representations → cognitive representations → long term memories involving time like entanglement and making possible historical self, suggests this.
3. 40 Hz band has a width of about 8 Hz, contains several cyclotron frequencies, is associated with the primary sensory areas and disappears during sleep. This suggests that also this band is involved with the projection of the sensory qualia to the sensory canvas. The information about narrow sub-bands of EEG during hypnagogic states (the state between wake-up and sleep involving sensory hallucinations), during the schizophrenic hallucinations and hallucinations generated by sensory deprivation, and during lucid dreaming could provide interesting constraints on the possible sensory quale-EEG frequency correlations.
4. A well motivated guess is that 3, 5 and 7 Hz bands do not correspond directly to the sensory qualia experienced by our magnetic body. Hippocampal theta band (which actually extends from about 4 to 12 Hz) could contain these narrow bands and be involved with the assignment of abstract features, such as concepts and verbal associations and emotions, to the sensory map crucial for the memories. The fact that alpha and theta waves are important during this period suggests that alpha and theta frequencies are involved with the generation of episodal memories.

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

### 4.3 How to test the sensory canvas hypothesis

In this subsection some tests for the new vision about sensory canvas hypothesis are proposed and some astrophysical phenomena possibly supporting the basic assumptions behind the new view are considered. The magnetospheric sensory representations associated with Mother Gaia, as opposed to the sensory representations realized at the personal magnetic body, are discussed in [N1].

### 4.3.1 Some simple tests

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

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

### 4.3.2 Tests for place coding

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

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

That retinas are involved with the attention is known for some time: directing the attention to an object of the visual field does not necessarily imply directing

the gaze to the object [37]. The amplification of the back-projections from frontal lobes to the part of retina in question is enough, and if the feedback exceeds a critical value the direction of the gaze is changed. This suggests that the mental image of the object of the perceptive field is realized at the retina and corresponding magnetic body and directing of attention to it feeds metabolic energy to this mental image. If the fundamental visual representation occurs at the level of retinas, the selection of the visual percept in the visual rivalry might be detectable at the level of retinas.

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

## 5 Generalized EEG as a basic control and communication tool of the magnetic body

The idea about p-adic fractal hierarchy of Josephson junctions is not new in TGD framework. The development of quantitative models based on this notion has been however plagued by the absence of concrete idea about what these Josephson junctions look like. The dark matter hierarchy based on hierarchy of scaled up values of Planck constant when combined with the p-adic length scale hierarchy allows to circumvent the problem.

An essential boost for the development of ideas have been the effects of ELF em fields in living matter explainable in terms of quantum cyclotron transitions in Earth's magnetic field. Especially the fact that these effects appear only in narrow temperature and amplitude windows has provided the key hints concerning the model for the hierarchy of Josephson junctions and EEGs. The discussion of these effects is left to a separate section.

### 5.1 Fractal hierarchy of Josephson junctions

The hierarchy of Josephson junctions involves actually two hierarchies, dark matter hierarchy and p-adic hierarchy, which can be said to be in resonance for living matter systems.

#### 5.1.1 Fractal hierarchy of dark copies of cell nucleus as a fundamental structure in living matter

There are actually two hierarchies. The first hierarchy correspond to the p-adic length scales for given value of  $\hbar$ . Second hierarchy corresponds to dark matter hierarchy for which length scales come in powers  $\lambda^{k_d} L(k)$  the basic p-adic length scales,  $\lambda \simeq 2^{11}$ . In fact there are arguments supporting the exactness of this value. Since 11 p-adic length scales combine naturally to form single

block in this hierarchy, there is strong temptation to assume that p-adic length scales  $k = 151, 147, 163, 167, 169$  form the fundamental block. Same length scale can have interpretation as several different p-adic length scales belonging to different levels of dark hierarchy. This is expected to induce an interaction between various levels of dark matter hierarchy.

The size of cell nucleus varies in the range ( $L(169) = 5 \mu m, 2L(169) = 10 \mu m$ ). This is consistent with the assumption that cell nucleus provides the fundamental representation for this block. This would mean that at least the multiply coiled magnetic flux quantum structures associated with DNA appear as fractally scaled up copies.

Each dark matter level corresponds to a block of p-adic length scales  $L(k)$ ,  $k = 151, \dots, 169$ . Also new length scales emerge at given level  $k_d$  and correspond to  $L(k)$ ,  $k > 169$ . The dark copies of all these length scales are also present. Hence something genuinely new emerges at each level.

The emergence of a genuinely new structure or function in evolution would correspond to the emergence of new level in this fractal hierarchy. Quantum criticality would be essential: phases corresponding  $k_d$  and  $k_d + 1$  levels would compete at quantum criticality. A good guess is that for all levels flux sheets traverse partially the DNA of possibly several cell nuclei and that they are part of Josephson junctions.

1.  $k_d = 0$  would correspond to cell nucleus since electronic and neutrino superconductivity correspond to ordinary  $\hbar$ .
2.  $k_d = 1$  would correspond to emergence of organs with sizes below 4 cm and bounded by epithelial sheets (double cell layers) of thickness about 10+10  $\mu m$ .
3.  $k_d = 2$  would correspond to layers of thickness 2+2 cm and structures with size smaller than 80 m. Obviously genuinely dark level is in question now. The layers of this Josephson junction could be assignable to left and right halves of central nervous system. The interpretation in terms of dark matter around the magnetic body of organs suggests also itself.  $k_d = 3$  corresponds to the emergence of double layered dark matter structures of thickness 40+40 m and size scale below 160 km. Now dark matter condensed around magnetic bodies of magnetic bodies of organs could be in question.
4.  $k_d = 4$  could correspond to the emergence of EEG assignable to flux sheets of personal magnetic body. The bilayered structure has thickness of 80+80 km and the analog of cell nucleus has minimum  $512 \times 160 = 8$  Mm and corresponds to Earth size scale (Earth radius is 6.96 Mm).

### 5.1.2 Fractal hierarchy of Josephson junctions and EEGs

The fractal hierarchy of Josephson junctions defining a fractal hierarchy of EEGs is the basic element of the model.

1. *Josephson junctions provide representation of electric field as biological action induced by generalized EEG*

Each junction has a background voltage over it and this voltage is independent of the p-adic length scale  $L(k)$ ,  $k = 151, \dots, 169$  inside block. Josephson current can be written as

$$J \propto \sin(2eVt + 2e \int V_1 dt) ,$$

where  $V$  corresponds to the background voltage analogous to resting potential of cell membrane and varies in rather narrow limits.  $V_1(t)$  represents external perturbation.

The frequency of  $V_1$  is represented as a period of periodic multiplicative modulation of the  $V_0$ .  $J$  itself is not periodic. There is however a periodicity with a period  $T = n/f$ , where  $f$  is frequency of  $V_1$  for  $f_J = mf/n$ . There are two interesting limits. For  $f_J^1 = 2eV_1/2\pi\hbar \gg f_J$  amplitude  $V_1$  is represented as frequency since in reasonable approximation frequencies  $f_{\pm} = f_J \pm f_J^1$  dominate. Second limit corresponds to  $f_J^1 \ll f_J$ . In this case the dominating frequencies are  $f_{\pm} = f_J \pm f$

Josephson frequency would define a kind of drum beat whereas the frequencies associated with  $V_1$  would represent the rest of the music. Josephson frequency  $f_J = eV/2\pi\hbar$  indeed turns out to belong to the scaled up variant of delta band of EEG and thus defines the analog of drum beat and corresponds to a resonance frequency in delta band for the scaled up variants of EEG. Josephson frequency defines a candidate for the time unit in which the time scale of memories and intentional action of the living system are measured.

The coherent photon state generated by  $J$  defines representation of  $V_1$  as a generalized EEG and biological representations result when the photons interact with the living matter.

The reactions of the Josephson junctions corresponding to different p-adic length scales  $k = 151, \dots, 169$  (if really present!) to external electric field are different due to  $V_1 \propto L(k) \propto 2^{(k-151)/2}$  proportionality and independence of  $V$  on  $k$ .

2. *Thermodynamical considerations*

Josephson energy does not depend on the level of dark matter hierarchy and is thus above thermal energy since this holds true in the case of cell membrane. From the resting potential whose nominal value is often taken to be for .08 V,  $f_J$  corresponds roughly to the energy 1.6 eV roughly twice the energy allowed by thermal stability. Thermal stability of drum beat would allow 140 °C temperature. The growth temperatures of thermophilic bacteria can be even higher than 100 °C.

Nerve pulse is generated when the potential drops to .05 eV: the corresponding Josephson energy is .01 eV which is above thermal threshold for  $T \leq 70$  C. For organisms possessing no nervous systems, in particular bacteria, this constraint is not relevant. The energy  $E = 1$  eV is twice the energy  $E = .05$  eV,

which is a universal transition energy of Cooper pairs of high  $T_c$  electronic superconductor [J1]. The generation of nerve pulse might involve these transitions.

### 3. Josephson frequencies

Resting potential corresponds to the Josephson frequency  $f_J = 5.95 \times 10^{13}$  Hz. Infrared radiation with intensity spectrum having characteristics of coherent state of photons would be a signature of this current. The Josephson frequency corresponding to threshold potential is  $f_J = 3.36 \times 10^{13}$  Hz.

$f_J$  scales like  $f_J \simeq \lambda^{-k_d}$  as a function of the level of the dark matter hierarchy. For  $k_d = 4$  one obtains  $f_J = 3.38$  Hz using  $\lambda = 2^{11}$ . This frequency belongs to delta band (defined as the the frequency range .25-5 Hz). For  $\lambda = 2.17 \times 10^3$  deducible from the model for planetary orbits as Bohr orbits the prediction is  $f_J = 2.68$  Hz.

### 5.1.3 Levels of dark matter hierarchy as a physical counterpart of chakras

The model identifying generalized EEG as coherent photons emitted by Josephson junction suggest that  $k_d = 7$  corresponds to the highest level of dark matter hierarchy for humans. This brings in mind the seven chakras central for Eastern mystic traditions. The magnetic flux quanta would enter the body through organs which are assignable to a particular value of  $k_d$  and chakras could be identified as groups of organs with a given value of  $k_d$ . An alternative possibility is that the space-time sheets at level  $k_d$  are joined to the level  $k_d + 1$  by Josephson junctions. In this case it is not necessary to have connections directly from the level of DNA. The magnetic bodies involved include the magnetic body associated with biological body, presumably that associated with  $k_d = 2$ , magnetic body of Earth for  $k_d = 4$ , magnetic body associated with plasma sheet at night side of Earth's magnetosphere, the magnetic body of Sun for  $k_d = 6$  and that of solar system for  $k_d = 7$ .

Josephson period associated with largest chakra would correlate with the time scales of intentional action and memories and would give a criterion making possible to estimate which levels are present for a given kind of organism or part of organism.

Of course, detailed one-to-one map between chakra picture and dark matter hierarchy is not possible. There are however common elements, most importantly the hierarchical structure of conscious experience leading from animal consciousness (root chakra) to cosmic consciousness (crown chakra). Chakra hierarchy should also have direct counterpart at the level of evolution of living organisms.

Hence it seems that two ideas, chakras and the idea about delicate interaction between astrophysical objects and human consciousness, hated bitterly by skeptics, find a natural place in dark matter hierarchy.

### 5.1.4 What is the precise value of $\lambda$ ?

The precise value of  $\lambda$  is important if one wants to assign the amplitude windows to resonance bands of EEG.  $\lambda = 2^{11}$  is definitely favored over  $\lambda = 2.17 \times 10^3$ .

1.  $\lambda = 2^{11}$  implies precise resonance between dark length scales and ordinary p-adic length scales. If  $\lambda$  is integer and if it equals to  $2^{11}$  then also lower powers of 2 can in principle appear in the dark matter hierarchy as sub-harmonics  $\lambda/2^k$  (in general division by integer factors of  $\lambda$  defines sub-harmonics).  $\lambda$  is predicted to depend logarithmically on p-adic length scale, and the enhanced number of levels in dark matter hierarchy resonating with p-adic length scale hierarchy could be seen as one reason for why 10 nm-20  $\mu\text{m}$  length scale is so special.
2. The interpretation of the Josephson period associated with the highest level of dark matter as the time scale for intentional action and memory allows to estimate the value of largest  $k$  relevant for humans and it turns out that the scaled up Josephson frequency corresponds to a period of 80 years for this option meaning that  $k_d = 7$  naturally corresponds to the highest level in the dark matter hierarchy associated with humans. For  $\lambda = 2.17 \times 10^3$  Josephson period is about 121 years and  $k_d = 7$  level of dark matter hierarchy is therefore not plausible.
3.  $\lambda = 2^{11}$  option also predicts for the length scale associated with  $k_d = 4$  Josephson junctions a value having direct physical interpretation.
4.  $\lambda = 2^{11}$  option provides more plausible interpretation for amplitude windows in terms of EEG resonance bands.

### 5.1.5 Josephson frequencies for various levels of dark matter hierarchy

The following tables list the Josephson frequencies for doubly charged current carriers for the levels of dark matter hierarchy corresponding to  $k_d = 0, \dots, 7$  using the value .08 V/m for the resting potential for  $\lambda = 2^{11}$  and  $\lambda = 2.17 \times 10^3$ . Note that there is no dependence on the p-adic length scale  $k = 151, \dots, 169$ . Also the frequencies corresponding to the .05 V corresponding to the potential at which nerve pulse is generated are listed. For singly charged bosonic ions the frequency would be  $f_J/2$ . For fermionic ions Josephson currents are not of course possible.

$k_d$	0	1	2	3
$f_J(80 \text{ mV})/Hz$	5.95e+13	2.91e+10	1.42e+07	6.93e+03
$f_J(50 \text{ mV})/Hz$	3.72e+13	1.82e+10	8.87e+06	4.33e+03
$k_d$	4	5	6	7
$f_J(80 \text{ mV})/Hz$	3.38	6.18e-4	2.85e-7	1.31e-10
$f_J(50 \text{ mV})/Hz$	2.11	1.0e-3	5.04e-07	2.46e-10

Table 3. The Josephson frequencies  $f_J = 2eV/2\pi\hbar$  of doubly charged particles for  $\lambda = 2^{11}$  corresponding to the resting potential .08 V and threshold potential .05 V for nerve pulse generation for  $\lambda = 2^{11}$ .

$k_d$	0	1	2	3
$f_J(80 \text{ mV})/Hz$	5.95e+13	2.74e+10	1.26e+7	5.82e+3
$f_J(50 \text{ mV})/Hz$	3.72e+13	1.71e+10	7.90e+06	3.64e+03
$k_d$	4	5	6	7
$f_J(80 \text{ mV})/Hz$	2.68	1.20e-3	5.70e-7	2.63e-10
$f_J(50 \text{ mV})/Hz$	1.68	7.73e-04	3.56e-07	1.64e-10

Table 4. The Josephson frequencies  $f_J = 2eV/2\pi\hbar$  of doubly charged particles corresponding to the resting potential .08 V and threshold potential .05 V for nerve pulse generation for  $\lambda = 2.17 \times 10^3$ .

Some comments are in order.

1. For  $\lambda = 2^{11}$  the Josephson period for  $k_d = 7$  is  $\simeq 80$  years, which roughly corresponds to the duration of human life cycle.  $k_d = 6$  corresponds to  $\simeq 14.3$  days and  $k_d = 5$  to  $\simeq 10.1$  minutes.
2. For  $\lambda = 2.17 \times 10^3$  the corresponding periods are 121 years,  $\sim 20.3$  days, and  $\sim 13.5$  minutes. Obviously  $\lambda = 2^{11}$  is favored over the value of  $\lambda$  deduced from astrophysical considerations.

## 5.2 What is EEG made of?

The usual classification of EEG frequencies by EEG bands is more or less a convention and the definitions of various bands vary in frustratingly wide ranges. In a more ambitious approach bands should be replaced with some substructures identified on basis of their physical origin and function. In the proposed framework this is possible. This identification of substructures of course applies only to that part of EEG from which noise is subtracted. The contribution of neural activity is one such source of noise, often regarded as the only contribution.

### 5.2.1 Basic contributions to EEG and ZEG

There are three fundamental contributions to EEG (or hierarchy of EEGs) besides the neuronal noise. This picture applies more or less as such also to ZEG.

1. Schumann resonances whose interpretation should be clear. These frequencies do not depend on magnetic field strengths assignable with magnetic flux sheets and characterize Earth's magnetic field and collective aspects of consciousness.
2. Cyclotron frequencies generated in cyclotron transitions of ions. An attractive guess is that cyclotron frequencies correspond to the control signals from magnetic body so that Josephson junctions and magnetic body

would form a closed feedback loop. These frequencies can be classified to those associated with bosonic and fermionic ions respectively. The transitions of Bose-Einstein condensates of bosonic ions are of special interest. The scale of these frequencies could be subject to homeostatic regulation which is local and can vary even inside genes of a given nucleus.

3. The frequencies generated by Josephson currents as coherent photons. Harmonics of cyclotron frequencies shifted upwards and downwards by Josephson frequency  $f_J = 3.72$  Hz. If the amplitude of the perturbation at cyclotron frequency is strong the EEG looks locally like it would consist of amplitudes with frequencies  $f_{\pm} = f_J^1 \pm f_J$  during most of the cyclotron period so that the visual inspection of time evolution of EEG can be rather misleading. Since these frequencies are involved with communications to the magnetic body of Earth, the natural guess would be that they correlate with the neural processing.

The following general overview about quantum communication and control emerges in this framework.

1. Cyclotron frequencies relate to the control of the biological body by the magnetic body and could be assigned with the magnetic flux sheets going through DNA since it is genome where protein synthesis is initiated and is thus the optimal intermediate step in the cellular control.
2. One of the basic functions of cell membranes is to perceive the chemical environment using various kinds of receptors as sensors. Neurons have specialized to receive symbolic representations of the sensory data of primary sensory organs about the situation in the external world. Receptor proteins would communicate cell level sensory input to the magnetic body via MEs parallel to magnetic flux tubes connecting them to the magnetic body. We ourselves would be in an abstract sense fractally scaled up counterparts of receptor proteins and associated with dark matter ion-lito Josephson junction connecting the parts of magnetosphere below lithosphere and above magnetosphere.
3. This picture would explain why the temperature of brain must be in the narrow range 36-37 K to guarantee optimal functionality of the organism. If interior superconductivity is lost, magnetic body receives sensory data but is paralyzed since its desires cannot be realized. If boundary superconductivity is lost, magnetic body can move but is blind.
4. In the length scales below the weak length scale  $L_w$  also charged weak bosons behave as massless particles and the exchange of virtual  $W$  bosons makes possible a nonlocal charge transfer. Dark quark-antiquark pairs associated with the color bonds of the atomic nuclei can become charged via the emission of dark  $W$  boson and thus produce an exotic ion. The same can happen at the higher levels of dark matter hierarchy. This provides a

nonlocal quantal mechanism inducing or changing electromagnetic polarization in turn inducing ordinary charge flows and thus making possible quantum control.

5. Massless extremals (MEs, topological light rays) serve as correlates for dark bosons. Besides neutral MEs TGD predicts also charged massless extremals obtained from their neutral counterparts by a mere color rotation (color and weak quantum numbers are not totally independent in TGD framework). The interpretation of the charged MEs has remained open hitherto. Charged  $W$  MEs (hierarchy of WEGs!) could induce long length scale charge entanglement of Bose-Einstein condensates by inducing exotic ionization of ionic nuclei. State function reduction could lead to a state containing a Bose-Einstein condensate in exotically ionized state.

In this manner the dark charge inside neuron and thus by Faraday's law also membrane potential could be affected by magnetic body. The generation of nerve pulse could rely on the reduction of the resting potential below the critical value by this kind of mechanism inducing charge transfer between cell interior and exterior. The mechanism might apply even in the scale of magnetic body and make possible the control of central nervous system. Also remote mental interactions, in particular telekinesis, might rely on this mechanism.

To sum up, charged massless extremals could be seen as correlates for nonlocal quantum control by affecting charge equilibria whereas neutral MEs would serve as correlates for coordination and communication. Color charged MEs could also induce color charge polarization and flows of color charges and thus generate visual color qualia by the capacitor mechanism discussed in [K3].

### 5.2.2 Classification of cyclotron frequencies

Consider now the classification of cyclotron frequencies.

1. Cyclotron frequencies can be classified those associated with atomic and molecular ions. For biologically important atomic ions most frequencies are above 7.5 Hz. For molecular ions frequencies are lower and for DNA sequences the frequencies are in delta band. Thermal stability condition suggest a lower bound of  $\sim 1$  Hz for significant frequencies of this kind. Thus it would seem that delta band dominating during deep sleep corresponds to DNA and possibly other bio-molecules and EEG during wake-up state corresponds to atomic ions.
2. Atomic ions can be classified into bosonic and fermionic ions. Practically all biologically important bosonic ions have  $Z = 2$  and in alpha band:  $f(^6Li^+) = 50$  Hz and  $f(Mg^{2+}) = 25$  Hz are the only frequencies above alpha band. Situation is essentially the same for biologically interesting ions too.  $^7Li^+$  is exception and corresponds to 42.9 Hz: as a fermionic ion it does not possess satellites and does not contribute to Josephson part of

EEG. Thus the frequency range 7.5 – 15 Hz is very strongly represented and expected to be fundamental.

3. Also the position in the periodic table of elements provides a classificational criterion but this criterion does not seem to be so useful as thought originally.
4. The integer  $n$  characterizing the harmonic of the cyclotron frequency in question is an additional classificational criterion and  $n$  could correlate with the character of neural processing.

### 5.2.3 Wake-up EEG

The question is whether this classification is consistent with the conventional decomposition into various bands and whether it allows to gain some real insights EEG. Consider first wake-up EEG [39].

1. The first implication is that each cyclotron frequency  $f_c$  is accompanied by two satellites  $f_c \pm f_J$ . For alpha band these satellites correspond to theta band and beta band identifiable as responses to control signals from magnetic body in alpha band. One can ask whether these bands as a whole correspond to the satellites of alpha band. This identification implies that both bands are present and makes sense for wake-up EEG but not as such for the EEG during first and second period of deep sleep during which theta band is present but higher bands are absent.
2. Sensorimotor rhythm in range (12-16) Hz is associated with physical stillness and body presence. The interpretation is as a low amplitude satellite of alpha rhythm with low amplitude control signals from the magnetic body so that rhythmicity is not lost and frequencies are clearly  $f_c + f_J$ .
3. Beta band is above 12 Hz and associated with active, busy or anxious thinking and active concentration and is chaotic and highly asynchronous. The natural interpretation is as large amplitude satellite of alpha band involving the activation of communications to the magnetic body and large control signals with  $f_J^1 \gg f_c$ . Hence the spectra would for a considerable part of period  $1/f_c$  effectively consist of frequencies  $f_{\pm} = f_J \pm f_J^1$ , where  $f_J^1$  varies in frequency range characterized by the amplitude of perturbation. There is no definite resonance frequency since  $\omega_1^J$  can vary continuously. Globally the situation is different since the spectrum can in principle be decomposed to frequencies  $f_J \pm n f_c$ . These two descriptions correspond to time domain and genuine frequency domain.

For sufficiently high harmonics of  $f_c$  the chaoticity disappears and frequencies  $f_J \pm n f_c$  become more manifest. The Josephson amplitudes of higher harmonics decrease as  $1/n f_c$ .

Beta band is predicted to have a mirror image in theta band during cognitive activity. The frequencies in theta band are assigned with cognitive

activities and memory recall. Note that also alpha band due to cyclotron frequencies should be present as well as the basic "drum beat" defined by  $f_J$  for  $f_J^1 \gg fc$ .

4. Odd higher harmonics of cyclotron frequency are expected to be the most important ones and would have interpretation as control signals from magnetic body. Satellites would correspond to responses to magnetic body involving entire 160 km thick Josephson junction but certainly correlating strongly with what happens in brain (recall the analog of biological body with a receptor at cell membrane).

For alpha band the third harmonics of most bosonic ions are in the range 28.2-34.2 Hz and roughly in gamma band above 30 Hz assignable with the control of cognitive activities from a flux quantum of Earth's magnetic field.

Fifth harmonics would be in the range 37.5-57 Hz. The fermionic ion  $Na^+$  would correspond to 65 Hz. During REM sleep EEG very similar to awake but 65 Hz resonance is present. One can ask whether fifth harmonics are present during REM sleep and serve as correlates for conscious visual imagery.

5. 40 Hz thalamocortical resonance band is very important EEG band. The upper satellite of the third harmonic of  $Mn^{2+}$  is 37.9 Hz. The third harmonics of fermionic ions  $^7Li^+$  and  $Na^+$  correspond to 42.9 Hz and 39 Hz (Schumann resonance) and have no satellites as fermionic ions.

#### 5.2.4 Satellites exist as mirror pairs

The existence of the mirror satellites might be regarded as a killer prediction. Amazingly, narrow EEG bands which are mirror images of each other with respect to alpha band have been reported [23]. Besides alpha band at 11 Hz, Nunez mentions also narrow sub-bands at 3, 5 and 7 Hz at delta and theta range, as well as the bands at 13, 15 and 17 Hz in beta band [23]. All these frequencies are expressible in the form  $f_c \pm f_J$ ,  $f_J = 5$  Hz, which is one half of the frequency 10 Hz of the memetic code and by 14 per cent higher than 3.7 Hz predicted assuming  $\lambda = 2^{11}$ . The value of  $\lambda$  deduced from these frequencies would be  $\lambda = 1902$  and about 7 per cent smaller than  $\lambda = 2^{11}$ . This estimate cannot be taken too seriously since it is quite possible that the thickness of Josephson junction is not scaled up completely exactly.

The cyclotron frequencies associated with the bands are 8, 10, and 12 Hz. The cyclotron frequencies of bosonic ions  $^{80}Se^{2-}$ ,  $^{64}Zn^{2+}$ , and  $^{55}Mn^{2+}$  for a magnetic field strength  $B = .526$  Gauss are 8.00, 9.90, and 12.00 Hz. The cyclotron frequencies of bosonic ions  $^{59}Co^{2+}$  and  $^{56}Fe^{2+}$  would be 10.52 Hz and 11.36 Hz and the satellites are at frequencies 5.52 Hz and 6.36 Hz and 15.52 and 16.36 Hz. All these frequencies belong to the bands reported by Nunez since their widths are 1-2 Hz. Thus the frequencies of all bosonic ions in alpha

band and in their satellites belong to the bands reported by Nunez for values of  $\lambda$  and  $B$  very near to their nominal values used in calculations!

With these assumptions the frequencies  $3f_c(Mn^{2+}) \pm f_J$  are 40.97 Hz and 30.97 Hz corresponding to 40 Hz band and the threshold of gamma band. That  $f_c(O^{2-}) = 39.6$  Hz is also in this band suggests additional reason for why oxygen is so important for consciousness.  $f_c(Mg^{2+}) = 26.3$  Hz is very near to Schumann resonance 26 Hz and its upper satellite corresponds to the threshold of gamma band.

What is also very remarkable that the 10 Hz magic frequency of the memetic code corresponding to the secondary p-adic length scale  $L(2, 127)$  associated with Mersenne prime  $M_{127}$  characterizing electron appears. It should be also noticed that  $f_J = 5$  Hz frequency corresponds to cognitive theta appearing during tasks requiring mathematical skills.

### 5.2.5 Alpha band dominance during relaxed state

In a relaxed state beta band disappears and the spectral power in alpha band increases. This seems to be in conflict with the idea that beta band is a mere satellite. There are two mutually non-inclusive manners to understand this.

1. The first possibility is that cyclotron frequencies in alpha band are not actually present and only Schumann frequency 7.8 Hz and 10 Hz resonance frequency associated with the excitations of electric field in ionospheric cavity behaving like 2-dimensional waves on sphere.
2. Second possibility is that ionospheric Josephson junction is somehow closed so that only the cyclotron contribution of various ions is present. This might be caused by DNA level mechanism which simply prevents the flow of the Josephson currents flowing along magnetic flux sheets through DNA strands. This mechanism would be completely analogous to the closing of ionic channel associated with cell membrane protein.

### 5.2.6 EEG during sleep

The EEG during sleep [40] provides a testing ground for the proposed anatomy of EEG. Sleep consists of 90 + 90 minute periods of NREM and REM sleep. This period is also the period of brain hemisphere dominances during wake up and day dreaming occurs with the same period as REM sleep. During REM sleep the EEG is essentially similar to that during wake-up. These observations inspire the hunch that brain hemisphere dominance dictates whether REM or NREM is in question. This turns out to be a correct guess.

#### 1. EEG during stage 1

During stage 1 theta of deep sleep [40] waves in frequency range 4-8 Hz dominate and amplitudes increase when frequency is reduced. The control signals from magnetic body are expected to be weak so that  $f_J^1 < f_J$  approximation should hold true implying that frequencies  $f_J \pm f_c$  should dominate and EEG

would look rhythmic rather than chaotic as indeed observed. The amplitudes behave as  $1/\omega_c$  and thus increase with decreasing  $\omega_c$ . The fact that amplitudes increase with decreasing EEG frequency suggests that the frequencies they correspond to different cyclotron frequencies.

These facts does not conform with the general picture as such. If theta and beta bands are mere satellites of alpha band, both of them should be present during stage 1 sleep but this is not the case. The idea that cyclotron frequencies of heavier ions in  $B_{end} = .2$  Gauss could replace those appearing during wake-up does not work. Theta band simply does not contain the cyclotron frequencies of biologically important ions for  $B_{end} = .2$  Gauss. One can imagine two manners to resolve the difficulty.

a) *Two manners to quantize magnetic flux*

One way out of difficulty seems to be that the value of the magnetic field  $B_{end} = .2$  Gauss associated with dark flux sheets is reduced by a factor of  $1/2$  to  $B_{end}/2 = .1$  Gauss so that the quantized magnetic flux reduces from  $2h_5$  to the minimal flux  $h_5$ . This looks very natural and would mean that the most important range 7.5-15 Hz of cyclotron frequencies would be scaled down to 3.75-7.5 Hz which indeed corresponds to the theta band. If one excludes  $Ca^{2+}$ , the range for bosonic ion reduces from 7.5 – 11.4 to 3.75 – 5.7 Hz. The satellites correspond to the range .05 – 8.7 Hz and 7.45 – 9.4 Hz plus  $Ca^{2+}$  satellites at 3.8 Hz and 11.2 Hz. With  $Ca^{2+}$  forming a possible exception, the resulting frequency ranges are consistent with empirical facts. Of course, it is quite possible that magnetic body does not generate cyclotron transitions at  $Ca^{++}$  cyclotron frequency.

The resolution of the puzzle might relate to the character of ions at the flux sheets in left and right hemisphere.

1. The quantization of magnetic flux reads as  $Ze \int B dS = n\hbar$  and for Cooper pairs and bosonic ions with  $Z = 2$  ( $Z$  refers to the absolute value of charge) it gives magnetic field strength which is one half from that for fermionic singly charged ions. Both fermionic ions with  $Z = 1$  and bosonic ions and Cooper pairs with  $Z = 2$  are allowed in this case by the single valuedness of wave functions. For  $Z = 2$  the quantization condition allows single valued wave functions for  $Z = 2$  ions or Cooper pairs only.
2. Assume the quantization condition corresponds to  $Z = 1$  for the right hemisphere and  $Z = 1$  for the right hemisphere. The presence of fermionic ions implies additional cyclotron frequencies on left hemisphere and the presence of fermionic ions conforms with the old proposal that fermionic Fock states provide a realization of quantal version of Boolean algebra. This conforms with the view that left brain is more reductionistic and performs linear logic operations whereas right brain is more holistic.
3. As a consequence the cyclotron frequency scale in right hemisphere is reduced by a factor of  $1/2$  and during right hemisphere dominated NREM sleep alpha band would be scaled down to theta band.

4. The prediction is that, apart from the Schumann frequencies and neural noise, left hemisphere EEG spectrum consists of right hemisphere EEG spectrum scaled up by a factor of 2 plus the contribution of fermionic ions and the Josephson satellites of these frequencies.

The assumption that the two quantization conditions correspond to just left and right hemispheres rather some other pair is of course un-necessarily strong and one can imagine also other correspondences.

*b) Exotic ions as a resolution of the problem?*

Second manner to achieve the scaling down of alpha band by a factor of 1/2 relies on the notion of exotic atomic nuclei.  $Z^0$  ions coupling to  $k = 113$  exotic weak bosons with  $k_d = 2$  result if some color flux tubes bonding the nucleons of nuclei to nuclear string become weakly charged. This means that a color bond having quark and antiquark at its ends becomes  $u\bar{d}$  type bond or its charge conjugate so that color bond becomes also em charged. There is evidence for this process. For instance, TGD explains the properties of tetra-neuron assuming that alpha particle with two negatively charged color bonds is in question [F8].

Exotic ion is not chemically equivalent with an ion of same em charge since the valence of the system is anomalous. For instance, as far as electronic shell is considered, the ion could behave like noble gas atom. Electronic ionization could also compensate exotic ionization so that an electromagnetically neutral but weakly charged ion would result. For instance, doubly charged bosonic ions could have em neutral counterparts with two units of weak charge (unit defined as the weak charge of  $u\bar{d}$  type color bond).

Since fermion number is not affected, singly charged exotic ion is boson for all nuclei with even neutron number, that is for the most stable nuclei. All biologically relevant ions might thus exist in bosonic states and form Bose-Einstein condensates. One can even wonder whether ions such as  $Na^+$ ,  $K^+$ , and  $Cl^-$  associated with cell are actually exotic ions and appear as Bose-Einstein condensates. For doubly charged bosonic ions, most of which are in alpha band, cyclotron frequencies of singly charged exotic counterparts would be halved. Also the Josephson frequency would be halved. For the first option this is not the case.

*2. EEG during stage 2*

Sleep spindles appearing in the state 2 of deep sleep are sudden increases in EEG amplitude and frequency from theta band to 12-16 Hz [41]. The spindles .5-1.5 seconds and appear with a period of about minute. In some sources frequency range 7-16 Hz is given as sleeping spindle range. The so called K-complexes are sudden increases in EEG amplitude but no change in frequency.

One interpretation is that sleep spindles correspond to the occasional wake-ups of the left hemisphere. Sleep spindles would thus correspond to the satellites of alpha band identifiable as responses of the corresponding Josephson junctions to occasional strong control signals at cyclotron frequencies in alpha band. K-complexes could be interpreted as signals from magnetic body to left hemisphere

but inducing no response. It might be that these sudden responses reflect the fact that the left brain is not fully asleep yet.

### 3. EEG during stages 3 and 4

Most of EEG power during deep sleep stages 3 and 4 is in the range .75-4.5 Hz [40]. This implies that control signals at cyclotron transition frequencies of ions from the magnetic body cannot be appreciably present and the control signals at cyclotron frequencies of molecular ions, such as DNA with cyclotron frequencies below 1 Hz, should be responsible for the EEG. The small amplitude of control signal implies  $1/f_c$  behavior and large amplitude as compared to the corresponding amplitudes at higher bands at weak amplitude limit.

Taking into account the fact that magnetic field strength is scaled down by factor of  $1/2$  this means that mass numbers of the ions in question must satisfied  $A/Z \geq 150$  for  $f_c \leq 1$  Hz. For DNA sequences with charge of 2 units per single base-pair one would have  $A \geq 300$ . The atomic weights for base pairs plus phosphate group and deoxyribose sugar are 327, 321, 291, 344 corresponding to A, T, C, G. Harmonics would be present also now but their contributions are small if the amplitudes of the control signals are small.

### 5. EEG during sleep and sensory canvas hypothesis?

The amplitudes associated with the higher EEG frequencies get much weaker during sleep. This is what sensory canvas hypothesis allows to expect since both sensory representations and the associated symbolic and cognitive representations are absent. Since no sensory and cognitive representations are present, no EEG MEs projecting the data to the sensory canvas need to be activated. This suggests that EEG frequencies associated with our sensory representations must be in alpha, beta and gamma bands. This first principle explanation for the reduction of EEG intensity in alpha, beta and gamma bands is actually highly nontrivial outcome of the sensory canvas hypothesis.

One can also deduce from the sensory canvas hypothesis which sub-selves can remain in wake-up state during sleep and possibly have sensory representations. It is known that 80 Hz range of EEG is not affected during sleep so that lower level selves could remain in wake-up state and wake-up also higher level cortical selves during dreams. For instance, the EEG frequencies associated with brain stem are of order 100 Hz whereas reticular formation corresponds to dominating rhythm of 200 Hz. It is natural to assume that these sub-selves remain in wake-up state and take care of the basic functioning of the body.

The process known as the consolidation of long term memories represent an example of a generalized motor activity of performed by the magnetic body during sleep. The gene expression required by the consolidation of long term memories in terms of conformational patterns of micro-tubuli would be simplest explanation for the presence of DNA cyclotron frequencies.

There could be also a transmission of abstract information from brain during sleep. For instance, the mirror mechanism of long term memories might be based on preferential entanglement of the wake-up brain with the sleeping brain so that maximal capacity would be available for memory function. One

could consider the possibility that EEG MEs at these frequencies project some features to magnetic selves which correspond to higher collective, multi-brained levels consciousness which wake-up during night time when the composite brains are not using their information processing capacity to the processing of sensory input and generation of motor output. The fact that neuronal activity continues also during sleep is consistent with this kind of shared use of brain. This hypothesis would assign the long sought fundamental function to sleep.

## 6 Support for the magnetic sensory canvas hypothesis

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

### 6.1 Atmospheric and ionospheric phenomena and sensory canvas hypothesis

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

#### 6.1.1 The sounds generated by auroras

There are claims that auroras generate audible sounds [16] (for the quantum model of auroras see [J3]). These sounds have not been detected by acoustic means. Of course, it might be only a matter of time when this is done.

A particular example of microwave hearing [42] could be in question. The microwave MEs generated in auroras could propagate like massless particles along ELF MEs to brain, and induce cortical perturbations modulated by ELF frequencies serving as modulating frequencies and determining the pitch of the sounds heard. The perturbations would be analogous to electric stimulation of cortex inducing sensory percepts by back-projection mechanism. The cortical perturbations would generate auditory sensations by the back-projection mechanism. Higher Schumann resonances are in the audible range and could also be mediated along the flux tubes from the magnetic body or magnetosphere to brain and induce audible sounds by the back-projection mechanism.

The TGD based model of hearing relies heavily on classical  $Z^0$  fields and auditory canvas could be actually  $Z^0$  magnetic. Since all classical fields are

expressible in terms of  $CP_2$  coordinates, magnetic storms are expected to be accompanied by their  $Z^0$  magnetic counterparts.

### 6.1.2 The sounds generated by meteors

so some further evidence for the sensory canvas hypothesis. Since 16th century it is known that also meteors produce audible sounds. What is mysterious that there is no time lag due to the propagation through the atmosphere. The explanation is that it is very low frequency em waves which propagate to Earth and generate sounds by interacting with the objects at the surface of Earth. Joined by the International Leonid Watch - Croatia (ILWC) project, a group of scientists presented the first instrumental detection of elusive electrophonic meteor sounds. In November 1998, the researchers from the Croatian Physical Society and the University of Kentucky organized an expedition to Mongolia to observe the anticipated Leonid meteor shower and shed some light on the phenomenon [17].

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

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

The recorded electrophonic sounds could be induced by electromagnetic perturbations propagating along magnetic mirrors at multiples of the fundamental frequency  $f = c/L$  determined by the length  $L$  of the magnetic mirror and the

mirrors might not only channel the electromagnetic energy very effectively but even act as resonators amplifying the em fields. In fact, in one of the models analyzed in [17], the electric fields on the surface of Earth must have the same strength as the electric fields created by the meteor in its immediate vicinity in order to explain the data! If the electric fields are channelled along the magnetic mirrors associated with the magnetic sensory canvases to the surface of Earth, the frequency spectrum is automatically in the 'thalamocortical' range instead of the expected 20 – 20.000 Hz range for the sferics and one can understand why only few meteors generate electrophonic sounds. Notice that magnetic mirrors of length shorter than Earth's circumference would give rise to higher resonance frequencies than Schumann frequencies: the required length of the mirror would be roughly 1.26 Earth radii for 40 Hz frequency.

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

1. One could construct acoustic amplifier in 37-44 Hz range so that human perceiver could hear both the direct ESP sound and the sound generated by the amplifier. This would mean hearing two 'pops', such that the interval between them is determined by the time used to the sensory processing and propagation of the sound from the external source. In fact, in the introduction of [17] it is mentioned that 'many witnesses heard sounds even before they heard the noise inside the house'. Assuming that the sounds are both heard and electronically detected, a neurophysiological model for the time lapse from the sensory input to the conscious percept would allow to test whether the consciously perceived sounds can have non-ESP origin. If the lag is too small, ESP interpretation is supported.
2. The human perceiver could use ear plugs. If 'pop' is heard also in this case, the only possible interpretation (excluding fraud) is that the sounds are generated either by the neuronal activity stimulated by the interaction of the ELF em perturbation with brain, that the sound is generated in body as physiophonic sound [54], or that a genuine ESP is in question. The phenomenon of physiophonic sound discovered by Antonio Meucci in 1842 means the amplification of external sounds or electromagnetic signals by musculature and their feed directly to the neural circuits (ears could be closed) and is a rather convincing explanation for the heard sounds. The possibility of fraud could be eliminated by excluding the possibility of the direct visual perception of the meteor and finding whether the heard sounds coincide with the electronically detected sounds.

### 6.1.3 UFOs, ETs and magnetic perturbations

Persinger has proposed a model explaining the encounters of extraterrestrials as hallucinations caused by the perturbations of Earth's magnetic field induced by the liberation of the tectonic energy at the lines of tectonic activity [45]. The

model is based on well-established statistics about the effects of the perturbations of Earth's magnetic field on consciousness collected in mental hospitals. The lines of the tectonic activity are also accompanied by well established luminous phenomena which suggests that the model could be naturally combined with the explanation of UFOs as this kind of luminous phenomena.

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

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

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

1. One could consider the possibility that a radial spray of electric flux emanates from the site of the tectonic activity and electrons accelerate in this field until they gain the energy needed to ionize the molecules of the atmosphere and produce visible light. The analog of vacuum discharge would be in question. The problem is that the drifting velocity is achieved very rapidly so that the model works only if the density of molecules of the atmosphere decreases sufficiently fast as function of height. This is not the case.
2. Suppose that the spot of tectonic activity emits  $k_{em} = 1$  dark microwave photons including frequencies  $f > 5$  GHz. In this case visible light could result via the de-coherence of the dark microwave photons to ordinary photons. The fraction of ordinary visible photons in the beam would behave as  $1 - \exp(-h/h_0)$  and at some critical height the beam would become visible as the visible photons scatter from the molecules of atmosphere.
3. Pseudo UFO could be a kind of a mini aurora produced by exactly the same mechanism as auroras. Similar mechanism could apply also to ball lightnings and other exotic luminous phenomena. The super-conducting magnetic flux tubes associated with the stream of magnetic flux assumed to emanate from the site of tectonic energy liberation would intersect with the magnetic flux tubes of Earth's magnetic field (or those emerging from the brain or body of the perceiver of ETs). This would lead to a reconnection process in which magnetic flux tubes having a local U-shape are generated. The inertia of the super-conducting ions (perhaps protons and electrons) would induce the leakage of the ions to the non-super-conducting atmospheric space-time sheet. This in turn would lead to a further ionization and the molecular electronic transitions would generate

the visible light as in the case of auroras. Also electric fields could be involved as in the case of auroras. U-shaped structures would occur at definite height. By measuring the local electromagnetic fields one could perhaps test whether the orbit of the pseudo UFO correlates with the variation of the hypothesized stream of magnetic flux emerging from the site of the tectonic activity. The pseudo-UFO character could be tested by finding what kind of radar echoes the luminous region generates (if any).

## 2. *What about ET reports?*

The aurora mechanism could explain also the hallucinations as real encounters with other selves of the predicted self hierarchy rather than ETs. The tectonic activity could cause a similar perturbation of the personal sensory canvas and perhaps its temporal fusion with other sensory canvases, perhaps even with higher multi-brained sensory canvases possibly present. This would obviously induce genuine ESPs. The generalized motor response coming from the sensory canvas would be also involved but primary percept would occur before it. Brain would probably do its best to interpret the situation using concepts provided by the cultural background. Angels, spirits, demons, ETs, etc.. would be various narratives for the same phenomenon.

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

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

### 6.1.4 **Anomalous visual percepts and sensory canvas hypothesis**

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

One can also consider the possibility of "vision" as a sensory experience of the magnetic body based solely on the ELF input from brain and body having no correlate with the visible light entering into the retina or even with neural activity. The de-coherence of (for instance) dark ELF photons with frequencies above alpha band at  $k_{em} = 4$  level of the dark matter hierarchy to ordinary visible photons could be responsible for this vision.

Even genuinely three-dimensional vision in which own body is seen as it would be seen by the external world suggests itself. The dropping of ions from the atomic space-time sheets to the magnetic flux tubes so that they end up to high  $n$  cyclotron states decaying via the emission of photons at frequencies which are harmonics of the cyclotron frequency would generate the projector MEs needed for the sensory representation of the physical body or part of it as seen by the environment.

There is some evidence for this kind of anomalous vision.

1. Yogis have reported altered states of consciousness in which they see their own body three-dimensionally, that is simultaneously from all directions. This might have interpretation as ELF vision involving a feedback from magnetic sensory canvas to brain to "qualify" the percept. An alternative interpretation is that the visual experience is visual experience of some other self which is shared by quantum entanglement.
2. Becker tells in his book "Cross currents" [46] about a young cancer patient who told that he can see the interior of his own body. The patient could also locate the remnant of the tumor correctly. If sensory receptors are necessary for visual qualia, the needed data must be received from somewhere by brain, and be projected to the retinas like during dreaming. The simplest option is that body parts can in some sense "see" each other. In particular, brain can "see" body parts (note that bacteria possess a primitive IR vision based on micro-tubules). Bio-holography provides support for the body as a hologram. For instance, an electric stimulation of ear during Kirlian imaging of a finger tip creates a Kirlian photo from which it is possible to abstract a hologram of ear (see [47] and [K5]). One can also imagine that magnetic body sees and the mechanism is the transformation of dark  $k_{em} = 4$  microwave photons to visible photons.
3. Also the OBE experiences, for instance those associated with NDEs, could have an analogous interpretation. The sensory input from eyes would be absent but brain would give feedback to visual receptors to "qualify" the the input which it might receive from other levels of self hierarchy. If even the input from neural activity is absent during NDEs so that the visual experience should be determined by the background ELF component emanating from the brain and body. The third person perspective associated with OBEs might be always present but be masked by the strong sensory input or by the absence of feedback to visual receptors. It is possible to have experiences about contact with deceased by a therapy based on rhythmic eye movements [52, 53]. The function of eye movements might

be to establish a feedback to certain brain regions serving as receivers of input from magnetic bodies of deceased or from magnetosphere. I have developed a detailed model for various kind OBE experiences in [H10].

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

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

## 6.2 Taos hum

Taos hum is an experimentally well-established anomalous phenomenon which has escaped rational explanations (in the article [54] a thorough review about nocturnal taos hum is given and the following representation relies on this article). Very concisely, taos hum seems to be apparently a subjective experience without identifiable objective counterpart and could thus provide an application for the sensory canvas hypothesis.

### 6.2.1 Basic facts

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

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

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

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

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

## **6.2.2 Phenomena possibly related to taos hum**

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

### *1. Microwave hearing*

During the collaboration with Joaquim Fernandez related to the construction of a model for so called Fatima miracle [51] I learned about the phenomenon of microwave hearing [42] in which microwaves generate an audible sensation. There is evidence that microwave hearing does not involve ears as receivers of the primary signal [48] and that the sensation of hearing could result as back-projection from cortex to ears.

This, and the correlation with microwave static suggest that taos hum could be a particular case of microwave hearing, and that the phenomenon involves ELF MEs along which microwave MEs propagate to the brain and body. The model of sensory representations implies that brain acts as a sending microwave antenna: a natural implication is that brain can act also as a receiving microwave antenna. The size of the brain hemisphere corresponds to a microwave frequency of order 3 GHz and smaller structures inside brain correspond to higher radio

frequencies. If primary sensory organs are the seats of the sensory qualia and that back-projections cannot induce physical pain, the presence of the painful tactile sensations means that microwaves must interact also with the sensory receptors at the skin.

### *2. Physiophonic effect*

Physiophonic effect is a phenomenon accidentally discovered by Antonio Meucci in 1842, in which vocal signals are electrically transmitted directly into the neurology of listeners [54]. Physiophonic sound can be often amplified to an enormous volume. A possible interpretation is as externally stimulated internal sound but one can of course wonder whether the transduction to sound is necessary.

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

### *3. Microwave static and taos hum*

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

## **6.2.3 Possible ingredients for the model for taos hum**

The facts about the role of the musculature, shortwave radio noise, and the role of acoustic environment combined with the model of microwave hearing based on the notion of dark photons [K6] give strong constraints on the model of taos hum.

### *1. Taos hum as sensitivity to alien control commands*

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

The situation would be due to the failure of the em (or rather, electro-weak) immune system of the patient. In order to understand what is involved a brief discussion of model of motor control based on charge entanglement induced by  $W$  MEs is necessary: a detailed model is discussed in [K5, K6].

1. The exotic ionization of dark matter induced by  $W$  MEs generates dark plasma oscillations inducing electric fields which by many-sheeted variant of the Faraday law induce electric fields also at the space-time sheets where ordinary matter resides. Various ionic waves, in particular  $\text{Ca}^{2+}$  waves and nerve pulse are examples of the physiological responses resulting in this manner.
2. Dark plasma frequency corresponds to a microwave photon with energy above the thermal threshold and the system must be able to provide dark photons with this energy to generate plasma oscillation patterns serving as control commands.

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

1. In the healthy situation em immune system takes care the the body is tuned to the personal dark plasma frequencies and does not respond to control commands from alien magnetic bodies associated with say plants.
2. In an un-healthy situation persons plasma oscillation frequencies are tuned to some frequencies in the microwave static and microwave static provides the energy needed to generate plasma wave patterns and thus to realize control commands from the alien magnetic bodies. The plasmoids would induce microwave hearing and generalized motor actions at cellular level exhausting the personal metabolic sources and leading to the painful experiences and fatigue.

### *2. Taos hum and microwave hearing*

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

Concerning the model for microwave hearing, a good guideline is that the effect is expected to be possible as quantum effect only if the energies of the microwave photons are above the thermal threshold. This would require dark microwave photons  $k_{em} = 1$  level of the dark matter hierarchy for which 5 GHz photons have energy above thermal threshold (6 cm wavelength). Same applies to other effects caused by dark microwave photons.

### *3. Taos hum and microwave seeing*

The de-coherence of microwave photons to ordinary photons would produce the biological effects. This could explain also the reported perception of white

light as resulting from the de-coherence of the microwave photons at the upper end of the spectrum: 1 mm microwave wavelength would correspond to 2.5 eV photon energy.

The de-coherence of dark microwave static to ordinary visible photons could make possible microwave vision during night time. This could explain why the static emerges after the sunset. Plants could also generate negative energy dark microwave photons with energies in the frequency bands of visible photons involved with photosynthesis to satisfy their metabolic needs when they do not receive sunlight. One can of course wonder whether the quartz in the rock heated during day-time could generate  $k_{em} = 1$  dark microwave photons during night-time serving as a metabolic source.

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

Taos hum starts immediately after the sunrise and stops after the sunset and seems to have a biological origin. The magnetic bodies of (say) plant cells could send  $k_{em} = 1$  dark energy photons at microwave frequencies above 5 GHz: one reason is that they become visible in this manner.

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

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

### *4. An explanation for 40-80 Hz modulation*

The model of bio-control based on dark matter hierarchy [M3] predicts that  $k_{em} = 4$  level of the dark matter hierarchy corresponds to EEG frequency range from the requirement that dark EEG photons have frequencies above the thermal threshold. This level is involved with all life forms capable of genetic expression, in particular plants. Therefore the ELF modulation of microwave frequencies could be due to the control commands from  $k_{em} = 4$  magnetic body normally meant to control the genetic expression of say plants. The modulation of the microwaves with EEG frequencies, in particular with the frequencies in the 37 – 44 Hz thalamo-cortical resonance band, could force the patient to stay awake by not allowing the dominant EEG frequencies to drop down to theta and delta region of EEG as occurs during sleep.

### *5. Is stochastic resonance involved?*

One could also ask whether the microwave static of victims of taos hum is anomalously amplified by some mechanism so that control commands from alien magnetic bodies can be realized. The transduction of weak microwave signals to mechanical oscillations by piezo-electric body liquid crystals, and the

amplification of this signal in the presence of a metabolic energy feed to the musculature, could lead to this kind of situation.

Stochastic resonance with white noise generated by body provides one possible amplification mechanism. Micro-wave frequency would correspond to the amplified frequency. If so, one could perhaps understand why only some persons experience the hum and why the effect is strong at night time. White noise would be generated by body. White noise induces jumps between the states of the 2-state system with an average frequency  $f_K$  (Kramers frequency) which depends on the autocorrelation function of the white noise and the properties of the 2-state system [M5]. If the Kramers frequency satisfies  $f_R = 2f$ , where  $f$  is the frequency of the signal, a resonant amplification occurs. The dependence  $f_K \propto \exp(-\Delta V/D)$ , where  $\Delta V > 0$  is the height of the potential barrier separating the states of the 2-state system, implies an exponential sensitivity of  $f_K$  on  $1/D$ , where  $D$  is the intensity of the white noise. Hence the failure of the immune system could be due to the too intense white noise produced by the body of the victim or due to a too low height of the potential barrier.

#### 6. Are electronic systems involved with the hum?

The fact that the number of victims of hum has rapidly increased during the era of radio communications and computers and suggests that both radio noise and computers might be actively involved with the hum. Also ELF noise from electronic systems might be important if these systems generate  $k_{em} = 4$  dark ELF photons.

Electronic instruments generate also frequencies in the range 40 – 80 Hz, in particular the 50 Hz frequency associated with the household electricity. Also submarine radars generate very strong ELF signals. The liquid crystal character of human body implies that besides weak sound signals also these ELF signals can contribute to the signal amplified by musculature. If these signals correspond to  $k_{em} = 0$  level of dark matter hierarchy, they should not have biological effects but whether this is the case is not all clear.

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

#### 6.2.4 Is hum possible in other sensory modalities?

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

effect as ESP the presence light sensation could be understood as visual aspect of the ESP.

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

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

1. The effect is caused by the de-coherence of dark microwave photons or perhaps dark  $k_{em} = 4$  EEG photons above alpha band to visible photons (during calm states of mind alpha band is very strong).
2. This effect is strongest when the eyes are only lightly closed. Perhaps ELF em waves from some source could provide the input to the retina which is magnetic structure and generate the visual sensation somehow (note that rotating non-colored Benham top can generate sensations of color). The de-coherence of  $k_{em} = 4$  dark ELF photons to ordinary visible photons could be the mechanism.
3. I have proposed an interpretation for the flow in terms of the magnetic flux tube structure emerging from the retina. One can however wonder why just single central vortex rather than two? Could it be that pineal gland, which is also a magnetic structure and contains retinal pigments and is 'third eye' in rather literal sense, could be responsible for the 'third eye' component of the flow, and that during eyes lightly closed conditions turbulent retinal and single vortex like pineal contributions superpose? Could pineal vision be based on the de-coherence of EEG waves above alpha band to ordinary visible photons?

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

### 6.2.5 Personal experiences about hum

While learning about taos hum, I suddenly realized that I am perhaps not an objective outsider at all! I cannot tolerate the humming noise of the refrigerator:

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

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

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

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

## References

### Online books about TGD

- [1] M. Pitkänen (2006), *Topological Geometroynamics: Overview*.  
<http://www.helsinki.fi/~matpitka/tgdview/tgdview.html>.

- [2] M. Pitkänen (2006), *Quantum Physics as Infinite-Dimensional Geometry*.  
<http://www.helsinki.fi/~matpitka/tgdgeom/tgdgeom.html>.
- [3] M. Pitkänen (2006), *Physics in Many-Sheeted Space-Time*.  
<http://www.helsinki.fi/~matpitka/tgdclass/tgdclass.html>.
- [4] M. Pitkänen (2006), *Quantum TGD*.  
<http://www.helsinki.fi/~matpitka/tgdquant/tgdquant.html>.
- [5] M. Pitkänen (2006), *TGD as a Generalized Number Theory*.  
<http://www.helsinki.fi/~matpitka/tgdnumber/tgdnumber.html>.
- [6] M. Pitkänen (2006), *p-Adic length Scale Hypothesis and Dark Matter Hierarchy*.  
<http://www.helsinki.fi/~matpitka/paddark/paddark.html>.
- [7] M. Pitkänen (2006), *TGD and Fringe Physics*.  
<http://www.helsinki.fi/~matpitka/freenergy/freenergy.html>.

## Online books about TGD inspired theory of consciousness and quantum biology

- [8] M. Pitkänen (2006), *Bio-Systems as Self-Organizing Quantum Systems*.  
<http://www.helsinki.fi/~matpitka/bioselforg/bioselforg.html>.
- [9] M. Pitkänen (2006), *Quantum Hardware of Living Matter*.  
<http://www.helsinki.fi/~matpitka/bioware/bioware.html>.
- [10] M. Pitkänen (2006), *TGD Inspired Theory of Consciousness*.  
<http://www.helsinki.fi/~matpitka/tgdconsc/tgdconsc.html>.
- [11] M. Pitkänen (2006), *Mathematical Aspects of Consciousness Theory*.  
<http://www.helsinki.fi/~matpitka/genememe/genememe.html>.
- [12] M. Pitkänen (2006), *TGD and EEG*.  
<http://www.helsinki.fi/~matpitka/tgdeeg/tgdeeg/tgdeeg.html>.
- [13] M. Pitkänen (2006), *Bio-Systems as Conscious Holograms*.  
<http://www.helsinki.fi/~matpitka/hologram/hologram.html>.
- [14] M. Pitkänen (2006), *Magnetospheric Consciousness*.  
<http://www.helsinki.fi/~matpitka/magnconsc/magnconsc.html>.
- [15] M. Pitkänen (2006), *Mathematical Aspects of Consciousness Theory*.  
<http://www.helsinki.fi/~matpitka/magnconsc/mathconsc.html>.

## References to the chapters of books

- [C6] The chapter *Was von Neumann Right After All* of [4].  
<http://www.helsinki.fi/~matpitka/tgdquant/tgdquant.html#vNeumann>.
- [C7] The chapter *Does TGD Predict the Spectrum of Planck Constants?* of [4].  
<http://www.helsinki.fi/~matpitka/tgdquant/tgdquant.html#Planck>.
- [E6] The chapter *Fusion of  $p$ -Adic and Real Variants of Quantum TGD to a More General Theory* of [5].  
<http://www.helsinki.fi/~matpitka/tgdnumber/tgdnumber.html#mblocks>.
- [E9] The chapter *Topological Quantum Computation in TGD Universe* of [5].  
<http://www.helsinki.fi/~matpitka/tgdnumber/tgdnumber.html#tqc>.
- [F8] The chapter *TGD and Nuclear Physics* of [6].  
<http://www.helsinki.fi/~matpitka/paddark/paddark.html#padnucl>.
- [H10] The chapter *TGD Based Model for OBEs* of [10].  
<http://www.helsinki.fi/~matpitka/tgdconsc/tgdconsc.html#OBE>.
- [H4] The chapter *Quantum Model for Sensory Representations* of [10].  
<http://www.helsinki.fi/~matpitka/tgdconsc/tgdconsc.html#expc>.
- [H6] The chapter *Quantum Model of Memory* of [10].  
<http://www.helsinki.fi/~matpitka/tgdconsc/tgdconsc.html#memoryc>.
- [H8] The chapter  *$p$ -Adic Physics as Physics of Cognition and Intention* of [10].  
<http://www.helsinki.fi/~matpitka/tgdconsc/tgdconsc.html#cognic>.
- [H9] The chapter *Quantum Model for Paranormal Phenomena* of [10].  
<http://www.helsinki.fi/~matpitka/tgdconsc/tgdconsc.html#parac>.
- [I3] The chapter *Biological Realization of Self Hierarchy* of [8].  
<http://www.helsinki.fi/~matpitka/bioselforg/bioselforg.html#bioselfc>.
- [J1] The chapter *Bio-Systems as Super-Conductors: part I* of [9].  
<http://www.helsinki.fi/~matpitka/bioware/bioware.html#superc1>.
- [J2] The chapter *Bio-Systems as Super-Conductors: part II* of [9].  
<http://www.helsinki.fi/~matpitka/bioware/bioware.html#superc2>.
- [J3] The chapter *Bio-Systems as Super-Conductors: part III* of [9].  
<http://www.helsinki.fi/~matpitka/bioware/bioware.html#superc3>.
- [K3] The chapter *General Theory of Qualia* of [13].  
<http://www.helsinki.fi/~matpitka/hologram/hologram.html#qualia>.

- [K4] The chapter *Bio-Systems as Conscious Holograms* of [13].  
<http://www.helsinki.fi/~matpitka/hologram/hologram.html#hologram>.
- [K5] The chapter *Homeopathy in Many-Sheeted Space-Time* of [13].  
<http://www.helsinki.fi/~matpitka/hologram/hologram.html#homeoc>.
- [K6] The chapter *Macroscopic Quantum Coherence and Quantum Metabolism as Different Sides of the Same Coin* of [13].  
<http://www.helsinki.fi/~matpitka/hologram/hologram.html#metab>.
- [M3] The chapter *Dark Matter Hierarchy and Hierarchy of EEGs* of [12].  
<http://www.helsinki.fi/~matpitka/tgdeeg/tgdeeg/tgdeeg.html#eegdark>.  
 The chapter *Dark Matter Hierarchy and Hierarchy of EEGs* of [12].  
<http://www.helsinki.fi/~matpitka/tgdeeg/tgdeeg/tgdeeg.html#eegdark>.
- [M5] The chapter *Quantum Model of EEG: Part II* of [12].  
<http://www.helsinki.fi/~matpitka/tgdeeg/tgdeeg/tgdeeg.html#eegII>.
- [N1] The chapter *Magnetospheric Sensory Representations* of [14].  
<http://www.helsinki.fi/~matpitka/magnconsc/magnconsc.html#srepres>.
- [N2] The chapter *Crop Circles and Life at Parallel Space-Time Sheets* of [14].  
<http://www.helsinki.fi/~matpitka/magnconsc/magnconsc.html#crop1>.
- [N3] The chapter *Crop Circles and Life at Parallel Space-Time Sheets* of [14].  
<http://www.helsinki.fi/~matpitka/magnconsc/magnconsc.html#crop2>.

## Physics related references

- [16] T. L. Hansen (2001), *The northern lights-what are they?*,  
<http://geo.phys.uit.no/articl/theaurora.html> .
- [17] G. Zgrablic *et al*(2001), *Instrumental recording of electrophonic sounds from Leonid fireballs*. To be published in Journal of Geophysical Research.  
<http://fizika.org/ilwcro/results/> . See also news release in same URL address.

## Biology

- [18] M. W. Ho (1993), *The Rainbow and the Worm*, World Scientific, Singapore.  
*Ibid* (1994), *Coherent Energy, Liquid Crystallinity and Acupuncture*,  
<http://www.consciousness.arizona.edu/quantum/Archives/Uploads/mifdex.cgi?msgindex.mif>.
- [19] R. Sheldrake (1995), *A New Science of Life: The Hypothesis of Morphic Resonance*, Inner Traditions Intl Ltd.

## Brain science, consciousness

- [20] B. Libet(1982), E. W. Wright , C. A. Gleason (1982), *Readiness potentials preceding unrestricted spontaneous and preplanned voluntary acts*, *Electroencephalography and Clinical Psychology* 54, 322-325.
- [21] B. Libet, E. W. Wright Jr., B. Feinstein, and D. K. Pearl (1979), *Subjective referral of the timing for a conscious sensory experience*, *Brain*, 102, 193-224.
- [22] S. Klein (2002), *Libet's Research on Timing of Conscious Intention to Act: A Commentary* of Stanley Klein, *Consciousness and Cognition* 11, 273-279.  
[http://cornea.berkeley.edu/pubs/ccog\\_2002\\_0580-Klein-Commentary.pdf](http://cornea.berkeley.edu/pubs/ccog_2002_0580-Klein-Commentary.pdf).
- [23] P. L. Nunez (2000), *Toward a Quantitative Description of Large Scale Neocortical Dynamic Function and EEG*, *Behavioral and Brain Sciences*, 23, (3): XX.
- [24] W. J. Freeman (2001), *Making sense of brain waves: the most baffling frontier in neuroscience*,  
<http://sulcus.berkeley.edu> .
- [25] T. H. Bullock (2001), *Signals and signs in the nervous system: The dynamic anatomy of electrical activity*.  
[http://cogprints.soton.ac.uk/documents/disk0/00/00/01/13/cog00000113-00/Signs\\_signals.html](http://cogprints.soton.ac.uk/documents/disk0/00/00/01/13/cog00000113-00/Signs_signals.html).
- [26] G. Rees (2001). *Neuroimaging of visual awareness in patients and normal subjects*. To appear in *Current Opinion In Neurobiology* 11(2), 2001.
- [27] J. Bullier (2001), *Feedback Connections and Conscious Vision*, To appear in forthcoming issue of *Trends in Cell Biology*.  
<http://www.trends.com> .
- [28] M. Perus (2001), *Neural correlates of vision and attention*,  
<http://ai.fri.uni-lj.si/xaigor/articles/perus2.doc>.
- [29] E. D. Lumer and G. Rees (1999), *Covariation of activity in visual and prefrontal cortex associated with subjective visual perception*. *Neurobiology*, Vol. 96, Issue 4, 1669-1673, February 16, 1999
- [30] A. Pascual-Leone and V. Walsh (2001). *Fast back projections from the motion to the primary visual area necessary for visual awareness*. *Science*, 292, 510-512.
- [31] I. Petersen and O. Eeg-Olofsson (1971), *The development of the electroencephalogram in normal children from the age of 1 through 15 years*. *Neuropaediatric*, 2.

- [32] G. Csibra *et al*(2000), *Gamma oscillations and object processing in the infant brain*. Science, Nov. 24;290(5496):1582-5.
- [33] T. A. Stroganova *et al*(1999), *EEG alpha rhythm in infants*. Clin. Neurophysiol. Jun; 110(6):997-1012.
- [34] Julian Jaynes (1982), *The origin of consciousness in the breakdown of the bicameral mind*, Princeton University Press.
- [35] T. W. Picton (2001), *What is encephalogram?*, <http://www.rotman-baycrest.on.ca/content/science/eegsub.html> .
- [36] A. Revonsuo (1998), *Is synchronization the direct neural correlate of visual consciousness?*, <http://www.phil.vt.edu/ASSC/engel/revonsuo1.html> .
- [37] T. Moore and K. Amstrong (2003), *Selective gating of visual signals by microstimulation of frontal cortex*, Nature 421, 370 - 373. <http://www.nature.com/>.
- [38] J.K. O'Regan and A. Noe (2000), *A sensorimotor account of vision and visual consciousness*, submitted 14 July 2000, as revision of manuscript under review in Behavioral and Brain Sciences. <http://nivea.psych.univ-paris5.fr> .
- [39] *Electroencephalography*, <http://en.wikipedia.org/wiki/Electroencephalography>.
- [40] *An Intro to Sleep: What is Sleep?* <http://www.talkaboutsleee.com/sleep-disorders/archives/intro.htm>.
- [41] *Sleep spindle*, [http://en.wikipedia.org/wiki/Sleep\\_spindle](http://en.wikipedia.org/wiki/Sleep_spindle).

## Effects of em fields on living matter

- [42] J. C. Lin, S. Sales-Cunha, J. Battocletti, A. Sances, (1980), *The Microwave Auditive phenomenon*, proceedings of the IEEE, vol. 68, #1.
- [43] Callahan, P. S. (1977). *Moth and Candle: the Candle Flame as a Sexual Mimic of the Coded Infrared Wavelengths from a Moth Sex Scent*. Applied Optics. 16(12) 3089-3097.
- [44] A. Schienle, R. Stark, R. Kulzer, R. Klpper and D. Vaitl (1996) *Atmospheric electromagnetism: individual differences in brain electrical response to simulated sferics*. International Journal of Psychophysiology, 21, 177.

- [45] M. Persinger (1999), *The tectonic strain theory as an explanation for UFO phenomena*,  
<http://www.laurentian.ca/www/neurosci/tectonicedit.htm>.  
 M. Persinger (1987) *Neuropsychological Bases of God Beliefs*, Praeger Publishers.  
 M. A. Persinger and S. Krippner (1989), *Dream ESP experiments and geomagnetic activity*, The Journal of the American Society for Psychical Research, Vol. 83.
- [46] R. O. Becker (1990), *Cross Currents*, Penguin Putnam Inc., New York .
- [47] M. Shaduri. & G.Tshitshinadze (1999), *On the problem of application of Bioenergography in medicine*. Georgian Engineering News 2, 109-112.  
 See also <http://www.bioholography.org/> .
- [48] C. E. Ingalls (2002), *Sensation of Hearing in Electromagnetic Fields*,  
<http://www.angelfire.com/or/mctrl/ingalls.htm> .
- [49] P. P. Gariaev *et al*(2002), *The spectroscopy of bio-photons in non-local genetic regulation*, Journal of Non-Locality and Remote Mental Interactions, Vol 1, Nr 3.  
<http://www.emergentmind.org/gariaevI3.htm> .

## Remote mental interactions, etc...

- [50] Jaan Suurkyla, *Transcendental Meditation - neuro-physiological transformation by way of a unique fourth state of consciousness*,  
<http://home.swipnet.se/tmdoctors/eng/tmunique.htm>.
- [51] F. Armada and J. Fernandez (1982), *Extraterrestrial Intervention in Fatima the Apparitions and the UFO phenomena*. Amadora, Livraria Bertrand.  
*Ibid.* (1995), *The Fatima Apparitions and the UFO Phenomenon*. Lisboa, Editorial Estampa.  
*Ibid.* (2002), *Fatima behind the Secret*. Lisboa, Ancora Editora.
- [52] A. L. Botkin (2000), *The Induction of After-Death Communications Utilizing Eye-Movement Desensitization and Reprocessing: A New Discovery*, Journal of Near-Death Studies, vol 18, no 3, p. 181.
- [53] F. Shapiro (1995), *Eye moment desensitization and reprocessing: Principles, processes and procedures*. New York, NY: Guilford.
- [54] G. Vassilatos (2001), *Nocturnal Disturbances and the Infrasonic "HUM"*,  
<http://www.borderlands.com/journal/nux.htm> .