

# TGD Based View about Classical Fields in Relation to Consciousness Theory and Quantum Biology

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### Abstract

In TGD Universe gauge fields are replaced with topological field quanta. Examples are topological light rays, magnetic/electric flux tubes and sheets, and flux quanta carrying both magnetic and electric fields. Flux quanta form a fractal hierarchy in the sense that there are flux quanta inside flux quanta. It is natural to assume quantization of Kähler magnetic flux. Braiding and reconnection are the basic topological operations for flux quanta.

The basic question is how the basic notions assigned with the classical gauge and gravitational fields understood in standard sense generalize in TGD framework.

1. Superposition and interference of the classical fields is very natural in Maxwell electrodynamics and certainly experimentally verified phenomena. Also the notion of hologram relies crucially on the notion of interference. How can one describe the effects explained in terms of superposition of fields in a situation in which the theory is extremely non-linear and all classical gauge fields are expressible in terms of  $CP_2$  coordinates and their gradients? It is also rather clear that the preferred extremals for Kähler action decompose to space-time regions representing space-time correlates for quanta. The superposition of classical fields in Maxwellian sense is impossible.

How can one cope with this situation? The answer is based on simple observation: only the *effects* of the classical fields superpose. There is no need for the fields to superpose. Together with the notion of many-sheeted space-time this leads to elegant description of interference effects without any need to assume that linearization is a good approximation.

2. Topological quantization brings in also braiding and reconnection of magnetic flux tubes as basic operations for classical fields. These operations for flux tubes have also Maxwellian counterparts at the level of field lines. Braiding and reconnection are in a central role in TGD Universe and especially so in TGD inspired theory of consciousness and quantum biology. The challenge is to build a coherent overall phenomenological view about the role of topologically quantized classical fields in biology and neuroscience. For instance, one can ask what is the precise formulation for the notion of conscious hologram and whether magnetic flux tubes could serve as correlates of entanglement (or at least negentropic entanglement suggested by the number theoretic vision and identified as a basic signature of living matter).
3. Topological quantization and the notion of magnetic body are especially important in TGD inspired model of EEG. The attempt to understand the findings of Persinger from the study of what is known as God helmet leads to a considerable progress in the understanding the possible role of topologically quantized classical fields in biology and neuro-science.

## 1 Introduction

In TGD Universe gauge fields are replaced with topological field quanta. Examples are topological light rays, magnetic/electric flux tubes and sheets, and flux quanta carrying both magnetic and electric fields. Flux quanta form a fractal hierarchy in the sense that there are flux quanta inside flux quanta. It is natural to assume quantization of Kähler magnetic flux. Braiding and reconnection are the basic topological operations for flux quanta.

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1. Superposition and interference of the classical fields is very natural in Maxwell electrodynamics and certainly experimentally verified phenomena. Also the notion of hologram relies crucially on the notion of interference. How can one describe the effects explained in terms of superposition of fields in a situation in which the theory is extremely non-linear and all classical gauge fields are expressible in terms of  $CP_2$  coordinates and their gradients? It is also rather clear that the preferred extremals for Kähler action decompose to space-time regions representing space-time correlates for quanta. The superposition of classical fields in Maxwellian sense is simply impossible.

How can one cope with this situation? The answer is based on simple observation: only the *effects* caused by classical fields superpose. There is no need for the fields to superpose.

Together with the notion of many-sheeted space-time this leads to elegant description of interference effects without any need to assume that linearization is a good approximation. Charged particles have topological sum contacts to several space-time sheets and experience the sum of the effects caused by the classical fields at all space-time sheets involved.

This picture allows also to understand how the many-sheeted space-time gives rise to effective space-time of GRT when sheets are collapsed to single sheet and metric replaced with sum of Minkowski metric and deviations of induced metrics of sheets from Minkowski metric. Gauge potentials are defined in an analogous way. Equivalence Principle in Einstein's form follows from Poincare invariance.

2. Topological quantization brings in also braiding and reconnection of magnetic flux tubes as basic operations for classical fields. These operations for flux tubes have also Maxwellian counterparts but for field lines and do not play so important role. Braiding and reconnection are however in a central role in TGD Universe and especially so in in TGD inspired theory of consciousness and quantum biology [K1]. Also 2-braiding in 4-D space-time is possible generalizes the quantum computation paradigm. The challenge is to build a coherent overall phenomenological view about the role of topologically quantized classical fields in biology and neuroscience.

For instance, the notion of conscious hologram [K3] is key concept in TGD inspired theory of consciousness, and the challenge is to formulate this notion more precisely. One can ask whether the presence of magnetic flux tubes connecting two systems could serve as a correlate of entanglement - or at least negentropic entanglement suggested by the number theoretic vision to be a basic signature of living matter.

3. Topological quantization and the notion of magnetic body are especially important in TGD inspired model of EEG [K14]. The attempt to understand the findings of Persinger from the study of God helmet (see <http://tinyurl.com/3cpoyq>) [J1, J7, J3] leads to a considerable progress in the understanding the possible role of topologically quantized classical fields in biology and neuro-science. In neurotheology the goal is to understand neurological aspects of spiritual experiences and near death experiences (see <http://tinyurl.com/yj523z>) [J4] (NDEs) and out-of-body experiences (see <http://tinyurl.com/2j342h>) [J2] [K15] are challenges for this approach. A good candidate for "God" as it appears in these experiences is magnetic body, perhaps a new layer added to the personal magnetic body during the experience. This explains also the paradoxical Brahman=Atman experience. TGD indeed predicts infinite hierarchy of selves with entire Universe at the top so that TGD view is not in conflict with the basic ideas of religion.

The appendix of the book gives a summary about basic concepts of TGD with illustrations. Pdf representation of same files serving as a kind of glossary can be found at <http://tgdtheory.fi/tgdglossary.pdf> [L2].

## 2 Comparison Of Maxwellian And TGD Views About Classical Gauge Fields

In TGD Universe gauge fields are replaced with topological field quanta. Examples are topological light rays, magnetic flux tubes and sheets, and electric flux quanta carrying both magnetic and electric fields. Flux quanta form a fractal hierarchy in the sense that there are flux quanta inside flux quanta. It is natural to assume quantization of Kähler magnetic flux. Braiding and reconnection are basic topological operations for flux quanta.

One important example is the description of non-perturbative aspects of strong interactions in terms of reconnection of color magnetic flux quanta carrying magnetic monopole fluxes [K5, K9]. These objects are string like structures and one can indeed assign to them string world sheets. The transitions in which the thickness of flux tube increases so that flux conservation implies that part of magnetic energy is liberated unless the length of the flux quantum increases, are central in TGD inspired cosmology and astrophysics. The magnetic energy of flux quantum is interpreted as dark energy and magnetic tension as negative "pressure" causing accelerated expansion.

This picture is beautiful and extremely general but raises challenges. How to describe interference and linear superposition for classical gauge fields in terms of topologically quantized classical fields? How the interference and superposition of Maxwellian magnetic fields is realized in the situation when magnetic fields decompose to flux quanta? How to describe simple systems such as solenoidal current generating constant magnetic field using the language of flux quanta?

## 2.1 Superposition Of Fields In Terms Of Flux Quanta

The basic question concerns the elegant description of superposition of classical fields in terms of topological field quanta. What it means that magnetic fields superpose.

1. In Maxwell's linear theory the answer would be trivial but not now. Linear superposition holds true only inside topological light rays for signals propagating in fixed direction with light velocity and with same local polarization. The easy solution would be to say that one considers small perturbations of background space-time sheet and linearizes the theory. Linearization would apply also to induced gauge fields and metric and one would obtain linear superposition approximately. This does not look elegant. Rather, quantum classical correspondence requires the space-time counterpart for the expansion of quantum fields as sum of modes in terms of topological field quanta. Topological field quanta should not lose their identity in the superposition.
2. In the spirit of topological field quantization it would be nice to have topological representation for the superposition and interference without any linearization. To make progress one must return to the roots and ask how the fields are operationally defined. One has test particle and it experiences a gauge force in the field. From the acceleration of the test particle the value of field is deduced. What one observes is the superposition of gauge forces, not of gauge fields.
  - (a) Let us just assume that we have two space-time sheets representing field configurations to be effectively superposed. Suppose that they are "on top" of each other with respect to  $CP_2$  degrees of freedom so that their  $M^4$  volumes overlap. The points of the sheets representing the field values that would sum in Maxwell's theory are typically at distance of  $CP_2$  radius of about  $10^4$  Planck lengths. Wormhole contacts representing the interaction between the field configurations are formed. Hence the analog of linear superposition does not hold true exactly. For instance, amplitude modulation becomes possible. This is however not essential for the argument.
  - (b) Test particle could be taken to be fermion which is simultaneously topologically condensed to both sheets. In other words, fermionic  $CP_2$  type almost vacuum extremal touches both sheets and wormhole throats at which the signature of the induced metric changes is formed. Fermion experiences the sum of gauge forces from the two space-time sheets through its wormhole throats. From this one usually concludes that superposition holds true for the induced gauge fields. This assumption is however not true and is also unnecessary in the recent case. In case of topological light rays the representation of modes in given direction in terms of massless extremals makes possible to realize the analogy for the representation of quantum field as sum of modes. The representation does not depend on approximate linearity as in the case of quantum field theories and therefore removes a lot of fuzziness related to the quantum theory. In TGD framework the bosonic action is indeed extremely non-linear (see **Fig. <http://tgdtheory.fi/appfigures/fieldsuperpose.jpg>** or **Fig. ??** in the appendix of this book).
3. This view about linear superposition has interesting implications. In effective superposition the superposed field patterns do not lose their identity which means that the information about the sources is not lost - this is true at least mathematically. This is nothing but quantum classical correspondence: it is the decomposition of radiation into quanta which allows to conclude that the radiation arrives from a particular astrophysical object. It is also possible to have superposition of fields to zero field in Maxwellian sense but in the sense of TGD both fields patterns still exist. Linear superposition in TGD sense might allow

testing using time dependent magnetic fields. In the critical situation in which the magnetic field created by AC current passes through zero, flux quanta have macroscopic size and the direction of the flux quantum changes to opposite.

## 2.2 The Basic Objection Against TGD

The basic objection against TGD is that induced metrics for space-time surfaces in  $M^4 \times CP_2$  form an extremely limited set in the space of all space-time metrics appearing in the path integral formulation of General Relativity. Even special metrics like the metric of a rotating black hole fail to be imbeddable as an induced metric. For instance, one can argue that TGD cannot reproduce the post-Newtonian approximation to General Relativity since it involves linear superposition of gravitational fields of massive objects. As a matter of fact, Holger B. Nielsen - one of the very few colleagues who has shown interest in my work - made this objection for at least two decades ago in some conference and I remember vividly the discussion in which I tried to defend TGD with my poor English.

The objection generalizes also to induced gauge fields expressible solely in terms of  $CP_2$  coordinates and their gradients. This argument is not so strong as one might think first since in standard model only classical electromagnetic field plays an important role.

1. Any electromagnetic gauge potential has in principle a local embedding in some region. Preferred extremal property poses strong additional constraints and the linear superposition of massless modes possible in Maxwell's electrodynamics is not possible.
2. There are also global constraints leading to topological quantization playing a central role in the interpretation of TGD and leads to the notions of field body and magnetic body having non-trivial application even in non-perturbative hadron physics. For a very large class of preferred extremals space-time sheets decompose into regions having interpretation as geometric counterparts for massless quanta characterized by local polarization and momentum directions. Therefore it seems that TGD space-time is very quantal. Is it possible to obtain from TGD what we have used to call classical physics at all?

The imbeddability constraint has actually highly desirable implications in cosmology. The enormously tight constraints from imbeddability imply that imbeddable Robertson-Walker cosmologies with infinite duration are sub-critical so that the most pressing problem of General Relativity disappears. Critical and over-critical cosmologies are unique apart from a parameter characterizing their duration and critical cosmology replaces both inflationary cosmology and cosmology characterized by accelerating expansion. In inflationary theories the situation is just the opposite of this: one ends up with fine tuning of inflaton potential in order to obtain recent day cosmology.

Despite these and many other nice implications of the induced field concept and of sub-manifold gravity the basic question remains. Is the imbeddability condition too strong physically? What about linear superposition of fields which is exact for Maxwell's electrodynamics in vacuum and a good approximation central also in gauge theories. Can one obtain linear superposition in some sense?

1. Linear superposition for small deformations of gauge fields makes sense also in TGD but for space-time sheets the field variables would be the deformations of  $CP_2$  coordinates which are scalar fields. One could use preferred complex coordinates determined about  $SU(3)$  rotation to do perturbation theory but the idea about perturbations of metric and gauge fields would be lost. This does not look promising. Could linear superposition for fields be replaced with something more general but physically equivalent?
2. This is indeed possible. The basic observation is utterly simple: what we know is that the *effects* of gauge fields superpose. The assumption that fields superpose is unnecessary! This is a highly non-trivial lesson in what operationalism means for theoreticians tending to take these kind of considerations as mere "philosophy".
3. The hypothesis is that the superposition of the effects of gauge fields occurs when the  $M^4$  projections of space-time sheets carrying gauge and gravitational fields intersect so that the sheets are extremely near to each other and can touch each other ( $CP_2$  size is the relevant

scale). Particles having topological sum contacts to these space-time sheets experience the sum of the gauge and gravitational fields associated with the space-time sheets.

A more detailed formulation goes as follows.

1. One can introduce common  $M^4$  coordinates for the space-time sheets. A test particle (or real particle) is identifiable as a wormhole contact and is therefore point-like in excellent approximation. In the intersection region for  $M^4$  projections of space-time sheets the particle forms topological sum contacts with all the space-time sheets for which  $M^4$  projections intersect.
2. The test particle experiences the sum of various gauge potentials of space-time sheets involved. For Maxwellian gauge fields linear superposition is obtained. For non-Abelian gauge fields gauge fields contain interaction terms between gauge potentials associated with different space-time sheets. Also the quantum generalization is obvious. The sum of the fields induces quantum transitions for states of individual space time sheets in some sense stationary in their internal gauge potentials.
3. The linear superposition applies also in the case of gravitation. The induced metric for each space-time sheet can be expressed as a sum of Minkowski metric and  $CP_2$  part having interpretation as gravitational field. The natural hypothesis that in the above kind of situation the effective metric is sum of Minkowski metric with the sum of the  $CP_2$  contributions from various sheets. The effective metric for the system is well-defined and one can calculate a curvature tensor for it among other things and it contains naturally the interaction terms between different space-time sheets. At the Newtonian limit one obtains linear superposition of gravitational potentials. One can also postulate that test particles move along geodesics in the effective metric. These geodesics are not geodesics in the induced metrics of the individual space-time sheets.
4. This picture makes it possible to interpret classical physics as the physics based on effective gauge and gravitational fields and applying in the regions where there are very many space-time sheets for which  $M^4$  projections intersect. The loss of quantum coherence would be due to the effective superposition of very many modes having random phases.

The effective superposition of the  $CP_2$  parts of the induced metrics gives rise to an effective space-time metric, which is not in general imbeddable to  $M^4 \times CP_2$ . Therefore many-sheeted space-time (see **Fig.** <http://tgdtheory.fi/appfigures/manysheeted.jpg> or **Fig. 9** in the appendix of this book) makes possible a rather wide repertoire of 4-metrics realized as effective metrics as one might have expected and the basic objection can be circumvented. In asymptotic regions where one can expect single sheetedness, only a rather narrow repertoire of “archetypal” field patterns of gauge fields and gravitational fields defined by topological field quanta is possible. This gives connection with quantum physics and state function reduction.

The skeptic can argue that this still need not make possible the embedding of a rotating black hole metric as induced metric in any physically natural manner. This might be the case but need of course not be a catastrophe. We do not really know whether rotating blackhole metric is realized in Nature. I have indeed proposed that TGD predicts new physics

new physics in rotating systems (see <http://tinyurl.com/yantmeot>) [K16]. Unfortunately, gravity probe B could not check whether this new physics is there since it was located at equator where the new effects vanish.

## 2.3 Induction coils in many-sheeted space-time

I have been trying to concretize many-sheeted space-time by thinking what simple systems involving electric and magnetic fields would look like in many-sheeted space-time. The challenge is highly non-trivial since the basic difference between Maxwell’s theory and TGD is that allows extremely limited repertoire of preferred extremals and there is no linear superposition.

1. By general coordinate invariance only 4 field like variables (say  $CP_2$  coordinates) are possible meaning that all classical fields identified as induced fields are expressible in terms of only four field like variables at at given sheet. This has several implications.

The classical field equations determining the space-time surface theory is extremely non-linear although they have simple interpretation as expression for local conservation laws of Poincare charges and color charges. Linear superposition of Maxwell's equations is lost.

Only for so called topological light rays ("massless extremals"), MEs) the linear superposition holds true but in extremely limited sense: for the analogous of plane waves travelling in either direction along ME. One has pulses of arbitrary shape preserving their shape and propagating in single direction only with maximal signal velocity.

2. Strong form of holography (SH) implies that 2-dimensional data at string world sheets and partonic 2-surfaces fix the space-time surfaces. 2-D data include also the tangent spaces of partonic 2-surfaces so that the situation is only effectively 2-D and TGD does not reduce to any kind of string model.

It is possible that the light-like 3-surfaces defining parton orbits as the boundaries of Minkowskian and Euclidian space-time regions possess dynamical degrees of freedom as conformal equivalence classes. Kac-Moody type transformations trivial at the ends of partonic orbit at boundaries of causal diamond (CD) would generate physically equivalent partonic orbits. There would be  $n$  conformal equivalence classes, where  $n$  would correspond to the value of Planck constant  $h_{eff} = n \times h$ . At the ends of orbit all these  $n$  sheets of the singular covering would co-incide. Possible additional degrees of freedom making partonic 2-surfaces somewhat 3-D would be therefore discrete and make possible dark matter in TGD sense.

What is clear that single space-time sheet is very simple entity, and one can assign to it only extremely limited set of say solutions of Maxwell's equations. More complex solutions must correspond to many-sheeted space-time surfaces approximated as slightly curved pieces of Minkowski space at the GRT-QFT limit of TGD.

This limit is discovered by noticing that a test particle touches all sheets of the space-time surface in a given region of Minkowski space - they are extremely near to each other. Test particle experiences sums for the induced gauge potentials and gravitational fields defined as deviations of the induced metric from flat Minkowski metric. These sums corresponds naturally to the gauge potentials and gravitational fields assignable to the GRT-QFT limit. One obtains GRT plus standard model.

The challenge is to look whether one can indeed construct typical Maxwellian field configurations as sums of electromagnetic gauge potentials represented as induced gauge potentials at various sheets. The simplest configurations would be realizable using only two sheets.

I have already considered the realization of standing waves not possible as single sheeted structures as  $\geq 2$ -sheeted structures carrying the analogs of sinusoidal waves [L3] (see <http://tinyurl.com/q4jyoc5>).

1. The proposal is that magnetic bodies (MBs) use this kind of standing wave patterns to generate biological structures: charged biomolecules would end up the nodal surfaces of the standing wave and become stationary structures. Of course, also time varying nodes are possible.
2. MB could use the MEs parallel to flux tubes connected to a given node of tensor network to generate biological structures at the node. Note that the interference pattern would be completely analogous to that of a hologram but allowing more than two waves. As a matter of fact, I considered a vision about living systems as conscious holograms for decades ago [K3] but was not able to invent a concrete model at that time. This Chladni mechanism - as one might call it - could be a general mechanism of morphogenesis and morphostasis.

Second challenge is provided by the field patterns of an inductance coil with AC current flowing around the boundary of cylinder.

1. The current is typically AC current. Oscillating magnetic field has direction parallel or opposite to the cylinder and electric field field lines rotate around the cylinder. That the geometry of field pattern is this is easy to understand by looking just the general form of the solutions of the Maxwell's equations in question.

2. What is essential is that one has standing wave type field pattern meaning that the fields at all points of the cylinder oscillates in the same phase. The temporal and spatial dependences of the magnetic field separate into product of sinusoidal function and spatial function, which in the simplest situation is constant. One might even regard the standing wave property as a signal of quantum coherence.

Could one use MEs as building bricks to construct the field pattern associated with the coil?

1. MEs define an extremely general set of (hopefully preferred) extremals of Kähler action. Basic type of ME corresponds to cylindrical regions inside which pulses propagate in the same direction along the cylinder and have transversal polarization. The simplest of them are form  $f_{\omega,k}(t, z, u) = \sin(\omega t - kz)\epsilon(u)$ , where one has  $\omega = kc$  and  $u$  is an arbitrary function depending on some coordinate of the plane orthogonal to the plane characterized by  $t$  and  $z$ . For instance,  $u$  could be chosen to be the radial coordinate  $\rho$  in cylindrical coordinates. The sum of the MEs with fields  $f_{\omega,k}$  and  $f_{\omega,-k}$  gives rise to an effective standing wave in the axial direction representing just right kind of magnetic and electric fields. The nodal surfaces correspond to the planes  $\sin(kz) = 0$  and to cylinders  $\epsilon(\rho) = 0$  in this case.
2. What is amusing that the field experienced by the test particle would be expressible as sum of the two modes of TGD counterpart of radiation field. If the AC frequency is 50 Hz, the period of radial cylindrical wave characterized by wave vector  $k = \omega/c$  ( $c = 1$ ) is of order wave length  $\lambda = 2\pi/k$ , which is of order  $10^7$  meters, order of magnitude of Earth radius! Hence the longitudinal magnetic field is essentially constant for the coils encountered in practical situation. Radial field depends on  $\rho$  or some more general transversal coordinate in very general manner.
3. The boundary of the cylinder carries the AC current. The description of this current is a further challenge to TGD and will not be considered here.

One can of course have more general currents generating much more general waves, not necessary standing waves.

1. The general recipe would be simple. These fields can be expressed as a Fourier decomposition of simple sinusoidal field patterns. Assign to each sinusoidal field pattern a space-time sheet in the proposed manner so that superposition for modes is replaced with union of space-time surfaces.
2. The more terms in the Fourier expansion, the larger the number of sheets for the many-sheeted space-time is. The number of space-time sheets gives a measure for the complexity of the system. For instance, a current with form of square pulse is an interesting challenge. Should one approximate the square pulse as a superposition of space-time sheets of its Fourier components?

## 2.4 The Notion Of Conscious Hologram

In TGD inspired theory of consciousness the idea about living system as a conscious hologram (see <http://tinyurl.com/ydx4fuk5>) [K3] is central. It is of course far from clear what this notion means. The notions of interference and superposition of fields are crucial for the description of the ordinary hologram. Therefore the proposed general description for the TGD counterpart for the superposition of fields is a natural starting point for the more precise formulation of the notion of conscious hologram.

1. Consider ordinary hologram first. Reference wave and reflected wave interfere and produce an interference pattern to which the substrate of the hologram reacts so that its absorption coefficient is affected. When the substrate is illuminated with the conjugate of the reference wave, the original reflected wave is generated. The modification of the absorption coefficient is assumed to be proportional to the modulus squared of the sum of the reflected and reference waves. This implies that the wave reflected from the hologram is in good approximation identical with the original reflected wave.



2. Conscious hologram would be dynamical rather than static. It would be also quantal: the quantum transitions of particles in the fields defined by the hologram would be responsible for the realization of the interference pattern as a conscious experience. The previous considerations actually leave only this option since the interference of classical fields does not happen. Reference wave and reflected wave correspond now to any field configurations. The charged particles having wormhole contacts to the space-time sheets representing the field configurations experience the sum of the fields involved, and this induces quantum jumps between the quantum states associated with the situation in which only the reference wave is present.

This would induce a conscious experience representing an interference pattern. The reference wave can also correspond to a flux tube of magnetic body carrying a static magnetic field and defining cyclotron states as stationary state. External time dependent magnetic field can replace reflected wave and induces cyclotron transitions. Also radiation fields represented by MEs can represent the reference wave and reflected wave. If there is need for the “reading” of the hologram it would correspond to the addition of a space-time sheet carrying fields which in good approximation have opposite sign and same magnitude as those in the sheet representing reference wave so that the effect on the charged particles reduces to that of the “reflected wave”.

This step might be un-necessary since already the formation of hologram would give rise to a conscious experience. On the other hand, the conscious holograms created when the hologram is created and when the conjugate of the reference wave is added give rise to two different conscious representations. This might have something to do with holistic and reductionistic views about the same situation.

3. One can imagine several realizations for the conscious hologram. It seems that the realization at the macroscopic level is essentially four-dimensional. By quantum holography it would reduce at microscopic level to a hologram realized at the 3-D light-like surfaces defining the surfaces at which the signature of induce metric changes (generalized Feynman diagrams having also macroscopic size - anyons (see <http://tinyurl.com/y89xp4bu>) [K10]) or space-like 3-surfaces at the ends of space-time sheets at the two light-like boundaries of CD. Strong form of holography implied by the strong form of general coordinate invariance requires that holograms correspond to collections of partonic 2-surfaces in given measurement resolution. This could be understood in the sense that the charged particles defining the substrate can be described mathematically in terms of the ends of the corresponding light-like 3-surfaces at the ends of CDs. The cyclotron transitions could be thought of as occurring for particles represent as partonic 2-surfaces topologically condensed at several space-time sheets.

One can imagine several applications in TGD inspired quantum biology.

1. One can develop a model for how certain aspects of sensory experience could be understood in terms of interference patterns for signals sent from the biological body to the magnetic body. The information about the relative position of the magnetic body and biological body would be coded by the interference patterns giving rise to conscious sensory percepts. This information would represent geometric qualia (see <http://tinyurl.com/y7vahkzg>) [K6] giving information about distances and angles basically. There would be a magnetic flux tube representing the analog of the reference wave and magnetic flux tube carrying the analog of reflected wave which could represent the effect of neural activity. When the signal changes with time, cyclotron transitions are induced and conscious percept is generated. In principle it there is no need not compensate for the reference wave although also this is possible.
2. The natural first guess is that EEG rhythms (see <http://tinyurl.com/y9y87z84>) [K4] (and those for its fractal generalization) represent reference waves and that the frequencies in question are either harmonics of cyclotron frequencies or linear combinations of these and Josephson frequency assignable to cell membrane (and possibly its harmonics). The modulation of the membrane resting potential would induce modulations of Josephson frequency and if the modulation is large enough it would generate nerve pulses. These modulations

would define the counterpart of the reflected wave. The flux tubes representing unperturbed magnetic field would represent reference waves.

3. For instance, the motion of the biological body relative to the magnetic body changes the signal at the space-time sheets carrying the signal and this generates cyclotron transitions giving rise to a conscious experience. Perhaps the sensation of having a body is based in this mechanism. The signals could emerge directly from cells. It could of course be that this sensation corresponds to lower level selves rather than us. Second option is that nerve pulses to brain induce the signals sent to the our magnetic body.
4. The motion of biological body relative to the biological body generates virtual sensory experience which could be responsible for the illusions like train illusion and the unpleasant sensory experience about falling down from cliff by just imagining it [K15]. OBEs (see <http://tinyurl.com/y797h78x>) could be also due to the virtual sensory experiences of the magnetic body. One interesting illusion results when one swims long time in windy sea. After the return to the shore one has rather long lasting experience of being still in sea. The explanation is that magnetic body gradually learns to compensate the motion of sea so that the perception of the wavy motion is reduced. At the shore this compensation mechanism however continues to work. This mechanism represents an example of adaptation and could be a very general mechanism. Since also magnetic body uses metabolic energy, this mechanism could have justification in terms of metabolic economy.

Also thinking as internal, silent speech might be assigned with magnetic body and would represent those aspects of the sensory experience of ordinary speech which involve quantum jumps at magnetic body. This speech would be internal speech since there would be no real sound signal or virtual sound signal from brain to cochlea.

5. Conscious hologram would make possible to represent phase information. This information is especially important for hearing (see <http://tinyurl.com/ybwqawhn>) [K11]. The mere power spectrum is not enough since it is same for speech and its time reversal. Cochlea performs an analysis of sounds to frequencies. It is not easy to imagine how this process could preserve the phase information associated with the Fourier components. It is believed that both right and left cochlea are needed to abstract the phase difference between the signals arriving to right and left ear allowing to deduce the direction of the source neural mechanisms for this has been proposed but these mechanism are not enough in case of speech. Could there exists a separate holistic representation in which sound wave as a whole generates a single signal interfering with the reference wave at the magnetic body and in this manner represents as a conscious experience the phase?
6. Also the control and reference signals from the magnetic body to biological body could create time dependent interference patterns giving rise to neural response initiating motor actions and other responses. Basically the quantum interference should reduce the magnitude of membrane resting potentials so that nerve pulses would be generated and give rise to motor action. Similar mechanism would be at work at the level of sensory receptors - at least retina. The generation of nerve pulses would mean kind of emergency situation at the neuronal level. Frequency modulation of Josephson radiation would be the normal situation.

### 3 Magnetic Body And Consciousness

In the following some aspects of magnetic body as a basic notion of TGD inspired theory of consciousness is discussed. The discussion emphasizes the difference between Maxwellian and TGD based view about gauge fields in which topological field quantization is in fundamental role. The central question concerns the TGD counterpart for the superposition of classical fields and the answer to this question distinguishes between TGD and Maxwell's electrodynamics and gauge field theories in general. These differences are essential for the vision about living systems as conscious holograms and also for the view about how the Josephson currents determined by cell membrane voltage give rise to representations of the geometry qualia at the magnetic body [K4, K12, K13]. Braiding and reconnection are basic processes changing the topology of the magnetic body and their interpretation in TGD inspired theory of consciousness is discussed briefly.

One might say that magnetic body is responsible for the third person aspects of consciousness. One could also perhaps say that magnetic body serves as an intentional agent using biological body as a motor instrument and sensory receptor. One must however remember that in TGD inspired theory of consciousness it is in principle wrong to speak about doers of deeds: only quantum jumps- deeds- are real. There is no need to postulate any permanent conscious entity, say “soul”. Almost by definition self assimilates with the regions of space-time from which the contents of consciousness are about and this corresponds to the region of embedding space where the non-determinism of quantum jump is located. Causal diamonds (see <http://tinyurl.com/yblbzk6x>) analogous to Penrose diagrams are the correlates of selves in this sense [K2]. Quantum jump involves a cascade proceeding from the level of CD to the level of sub-CDs identified as correlates of sub-selves interpreted as mental images of self. Negentropy Maximization Principle (see <http://tinyurl.com/yd3mly5m>) implies that the cascade stops when it is not possible to generate negentropy by reducing entropic entanglement [K8].

### 3.1 Questions

It is perhaps best to proceed by making questions. In some other mood I would perhaps use more determined approach and replace questions with assumptions. The basic question is what does one really mean with magnetic body?

1. Is magnetic body a separate entity and connected to biological body with magnetic flux tubes which are like “threads” ? What happens to magnetic body when biological body moves. Does magnetic body move along like a rigid part of body? Or does it remain stationary and the sensation of movement results from the relative motion of magnetic body and biological body. Is magnetic body like observer looking at biological body. Is it responsible for the third person aspect of consciousness?
2. What part of sensory percept and its cognitive representation magnetic body is responsible for? The hypothesis is that sensory organs are seats of the primary qualia and the virtual sensory input from brain allows to build standardized mental sensory mental images. Magnetic body would be responsible for the “geometric” qualia such as distance, angles, positions of objects of perceptive field. The representation at magnetic body would provide the organization of sensory input to percepts consisting of objects. Position of sensory percept would correspond to a position at magnetic body: for instance the pattern associated with a sensation of touch (it is possible to “see” through tactile sense). The interference with connections to magnetic body and affecting signals sent to magnetic body should affect these aspects of sensory perception and cognition.

Magnetic body can be regarded as a virtual body. For instance, OBEs (see <http://tinyurl.com/y797h78x>) could be understood in terms of magnetic body. Moving train illusion is an everyday example about OBE [K15]. Personal magnetic body representing also the train starts to move with respect to biological body and in this manner creates the percept about moving train. The unpleasant sensation of falling down from a cliff could be a virtual world effect resulting from the motion of magnetic body relative to biological body. Interference patterns for radiation from biological body to magnetic body. Conscious holograms are responsible for the generation of sensory percepts at the magnetic body and also for the realization of control signals from magnetic body generating nerve pulse patterns give rise to motor actions.

3. What does the connection between body and magnetic body mean? Flux tubes from body -, which can be moving - to the stationary part of the magnetic body? Somewhat like neural pathways from muscles to brain. Biological body is the motor instrument changing its shape and position under the control of magnetic body. Magnetic body uses biological and is relatively stationary in the first approximation. Real motion to the situation in which biological body moves. Of course, also magnetic body can have motor activity and this can be very important for living matter

“DNA as topological quantum computer” (see <http://tinyurl.com/ybyscdpt>) based on braiding of the flux tubes [K1] and the reconnection processes at the level of biological body

accompanying metabolism [K7] ). Imagined motion could correspond to a situation in which magnetic body moves.

### 3.2 Magnetic Body And Conscious Holograms

The idea about bio-systems as conscious holograms involves in an essential manner the TGD counterpart for the interference and superposition of classical fields.

1. The TGD based description for interference and superposition of classical fields has been already discussed. Consider two parallel space-time sheets - now magnetic flux tubes. Assume that charged particles having wormhole contacts to both sheets are present and therefore experience effectively the sum of fields associated with the two sheets. Interference pattern is represented as the transition probability as a function of  $M^4$  position. In stationary situation no transitions take place.
2. When the relative position of the biological body and magnetic body change - in particular, when the distance between magnetic body and biological body is changed - the interference pattern changes so that either a motion of biological body or magnetic body is experienced as a real motion. This could explain could assign to the sensory percept what could be called geometric qualia such as the position of the sensation represented as a position at magnetic body.
3. The motion of the magnetic body relative to stationary biological body can give rise to virtual world sensory experiences carrying only the geometric qualia. This could give rise to imagination and thinking as internal speech involving all aspects of speech except those assignable to the primary sound quale at cochlea. This would also explain the unpleasant sensation of falling down when one is near cliff.
4. Magnetic body could also move so that the motion of the biological body is compensated so that the metabolic energy used in quantum transitions giving rise to the conscious experience is minimized. Example: swimming a long time swimming in sea creates the experience of being in sea after one has returned to the shore. Magnetic body learns to compensate the motion in sea so that the waves are hardly observed. At the shore this mechanism continues to work and create illusion of being in sea.
5. Correlational opponent processing seems to be a more general concept inspired by this phenomenon. Ron Blue has proposed in his correlational opponent-processing theory (see <http://tinyurl.com/y76w9bz4>) that right and left hemisphere form opponents for each other creating opposite reactions. The above argument suggests that magnetic body and biological body could form this kind of pair. Magnetic body would tend to generate compensating effect cancelling the effect caused by motion of biological body with respect to magnetic body to minimize metabolism. This would in general lead to a habituation.
6. Opponent process-theory (see <http://tinyurl.com/348fwq>) is a psychological and neurological model inspired by the observation that emotional response is often followed by its opposite. Could also this phenomenon relate somehow to the relationship between biological and magnetic body? This does not look plausible. Maybe generalized second law of thermodynamics (see <http://tinyurl.com/ybg8qypx>) [L1] - stating that although the generation of genuine negentropy is possible locally it is always compensated by a generation of entropy somewhere else - could provide more natural explanation for this.

### 3.3 Topological Effects On Magnetic Flux Quanta Affecting The Biological Body-Magnetic Body Connection

Magnetic flux tubes make possible braiding and reconnection of flux tubes. These processes are fundamental in TGD inspired quantum biology. Braiding and reconnection are also possible for magnetic field lines and therefore in Maxwellian electrodynamics.

1. Braiding of flux tubes makes possible topological quantum computation like processes. This leads to the idea about DNA as topological quantum computer (see <http://tinyurl.com/ybyscdpt>) [K1]. p-Adic fractality implies that there are flux tubes inside flux tubes defining braids with braids. Also the connections between biological body and magnetic body could define braids and make possible quantum computation like processes. Could it be possible to affect braiding artificially and affect cognition?
2. Reconnection of flux tubes is second topological process. Reconnection process for flux tubes changes the topology of the magnetic field. For instance, magnetic storms and auroras involve reconnection process occurring in astrophysical scale. Currents flowing along flux tubes are redistributed in the process. The proposal is that flux tubes serve as correlates of attention [K1]. In living matter at cellular level the reconnections of flux tubes connecting flux tubes would be occurring all the time. The process transforming ATP to ADP and vice versa could be seen as a reconnection at molecular level.

Could reconnection between flux tubes connecting two magnetic bodies A and B - say those assignable to brain hemispheres or two subject persons - leading to a splitting of the connection between the magnetic bodies take place. Could this give rise to a kind of split brain syndrome (see <http://tinyurl.com/s38z2>). Signals from biological body **a** would go to magnetic body B and magnetic body B could induce motor actions at **a**. Does hypnosis involve reconnection? Flux tubes from the subject person (hypnotizer) would not go to her magnetic body but the magnetic body of hypnotizer (subject person)? Hypnotizer uses the magnetic body of the subject person. Is becoming possessed something like this?

3. Two flux tubes leading from biological body to magnetic body could reconnect. To parallel flux tubes- II - would transform to cup and cap. Also the closed flux tubes of the external magnetic field could reconnect with the flux tubes connecting left and right magnetic bodies so that the connection between magnetic bodies is via the magnet which is inanimate matter which entangles entropically. If the magnetic flux tube connections between living systems are correlates for negentropic entanglement, then their splitting or transformation to those between living and inanimate system could mean the transformation of entanglement to entropic entanglement unstable under state function reduction. Could this take place in the experiments of Persinger and lead to a split brain situation and to visitor experiencers?

### 3.4 FM Modulations Of Membrane Potential As Code Of Consciousness?

What AM/FM modulation means using the language of topologically quantized fields? The answer to this question might provide new insights also about whether AM or FM is more natural at quantum level.

1. Does the presence of two space-time sheets whose  $M^4$  projections overlap imply amplitude modulation? Does the modulation of distance between charged plates induce the modulation of voltages which in turn induces modulation of ohmic current which in turn induces modulation of the amplitude of radiation. Note that for Josephson junction - cell membrane is regarded as Josephson junction [K12] - it is *frequency* of Josephson radiation which is modulated.
2. Could frequency modulation reduce to the modulation of magnetic fields or to the modulation of membrane potential inducing the modulation of Josephson frequency?
3. The carrier frequency of speech suffers frequency modulations. Whale song involves frequency modulation. Note that artificially slowed down speech is also strongly frequency modulated.
4. Could it be that at quantum level FM is more natural? Could FM allow to realize some kind of code. In the model of hearing FM for Josephson frequencies of cell membrane induced by amplitude modulation of the membrane potential represent sound frequencies. The representation is based on resonances at the period of sound wave when absorption occurs at cyclotron resonance at the magnetic body.

The cautious conclusion is that FM by periodic or more general temporal pattern induces a variation of membrane potential. This induces a variation of Josephson frequency affecting in turn the input to magnetic body and could generate interesting effects on consciousness and behavior. If the amplitude of the modulation of the membrane potential has too large amplitude, nerve pulse is generated and has more drastic effect.

## 4 The Relation To Persinger's Work

Anyone - atheist or believer - wanting to learn about Persinger's work and the basic insights of neuro-theology should listen the extremely inspiring talk *God and the Brain - The Persinger "God Helmet", The Brain, and visions of God* (see <http://tinyurl.com/y83pq5v1>) by Todd Murphy [J3]. Persinger's work (for references to the articles by Persinger and collaborators see the Wikipedia article about God helmet at <http://tinyurl.com/3cpoyq>) suggests that the temporal pattern of the modulation of magnetic field strength (FM would be in question for slow variations) is important. We do not however know the "code". Also the strength of the magnetic field can be important. Note that the effects of very weak ELF em fields on vertebrate brain (see <http://tinyurl.com/y9y87z84>) take place in amplitude windows [K4].

The modulation of magnetic field would probably induce FM of cyclotron frequencies. The model for hearing (see <http://tinyurl.com/ybwqawhn>) suggests this kind of modulation as a way to represent the frequencies of the sound wave. Also phase information is very important: time reversed speech sounds very different as normal speech but has the same power spectrum. Modulations would be slow in the time scales defined by the audible frequency range..1 seconds would represent lower limit for the variation rate of modulation. Audible frequencies above 20 Hz.

### 4.1 God Helmet

God helmet (see <http://tinyurl.com/3cpoyq>) or Koren helmet named after its inventor is the device used by Persinger and collaborators to study the effects of magnetic field on consciousness. Transcranial magnetic stimulation is not in question: TCMS uses fields of order Tesla whereas Persinger uses magnetic fields with strength of order.01 Gauss. This is 2 per cent of the nominal value of Earth's magnetic field. There is a coil above both temporal lobes and the active coil rotates counterclockwise.

1. At the first stage the coil above right temporal lobe rotates counterclockwise. A chirp sequence is used. Chirp means use of an oscillating magnetic field with maximum amplitude about 1 microTesla with oscillation frequency going gradually down. The interpretation is that right-brain self is activated and dominates conscious experiences. The experiences have negative emotional coloring and sometimes the subject person has even fearful experiences.
2. At second stage both coils rotate counterclockwise. The signal is derived from amygdala and hippocampal EEG. Faraday cage is used to eliminate external electromagnetic perturbations and also sensory deprivation is necessary (subject person is blind-folded and in an acoustic chamber). Earth's magnetic field is present, which might have relevance and is indeed used in experiments related to the hypothesis that the variations in Earth's magnetic field affect consciousness.

A burst of left brain activity is reported to take place during second stage. Also visitor experience is reported to occur during this period. This can mean meeting of God/light being, of angels, of deceased or of group of "beings", or just sense the presence of some conscious entity. A strong sense of meaning can accompany the experience. 80 per cent of subject persons experience at least the sense of presence.

### 4.2 Persinger's Experiments And Cyclotron Frequencies?

A more quantitative description of the God helmet experiment assuming that cyclotron frequencies are essential goes as follows.

1. The field strength used by Persinger is of the order .01 Gauss and very weak and different from  $B_{end} = .2$  Gauss which is  $.4B_E$  with  $B_E = .5$  Gauss the nominal value of the Earth's magnetic field. Cyclotron frequencies are by a factor of order  $1/20$  smaller than for  $B_{end}$ . This gives .75 Hz for  $Ca^{++}$ .

From this it is clear that the changes of cyclotron frequencies would be small in static external field in Persinger's experiments and could be treated as a small perturbation. External magnetic field could superpose with  $B_{end} = .2$  Gauss and affect cyclotron states and induce transitions between them. This would induce effects on EEG visible as frequency modulations. It seems that the period for the oscillation of  $B$  must be longer than cyclotron period for this picture to make sense.

2. One expects a fractal hierarchy of field strengths for endogenous magnetic fields and  $B \simeq .01$  Gauss could correspond to higher levels of consciousness so that cyclotron frequencies for these fields would be important. In this case the external magnetic field would not be a small perturbation. The cyclotron frequencies of DNA strand carrying charge density of 2 elementary charges per nucleotide from the phosphates depend only weakly on the length of DNA strand and are about 1 Hz in  $B_{end}$ . Could the cyclotron radiation from cyclotron states associated with the external magnetic field induce interaction with DNA cyclotron states in field  $B_{end} = .2$  Gauss?
3. Consider next the time scales. The stimulation of right brain lasts during the first stage last about half an hour. There are however many lacking bits of data.
  - (a) In what range are the values of the rotation frequency for the magnetic field? ELF frequencies are used [J7]. If EEG frequencies are in question the rotation should be slower what the lowest EEG frequency involved and below 1 turn per second.
  - (b) The rotated magnetic field is time dependent. Chirp sequences are used to stimulate temporal lobe. What is the duration of single chirp and the frequency range covered during chirp? A good guess is that the frequency range is that of EEG. The natural expectation is that the duration of chirp is much longer than the periods in the frequency range considered. This would mean that one scan entire frequency range and that it makes sense to say that the changes of frequency during chirp is slow as compared to the instantaneous frequency.
  - (c) EEG signals from left amygdala or hippocampus are used to stimulate both temporal lobes during the second stage. This means that their natural frequency scale should be in the range 1-100 Hz. These time scales would be shorter than the time scale of order 1 second assignal to  $Ca^{++}$ . This suggests that small amplitude modulation of the cyclotron frequencies in EEG range is in question. The signals sent to the magnetic body would be determined by this modulation and at least in the second stage this modification would carry information.

### 4.3 Persinger's Explanation

Persinger's own explanation relies on what might be called neurotheology (see <http://tinyurl.com/bm76c>) [J5].

1. The basic claim of Persinger is that the experiences in question are produced by brain so that meeting of God would not be real. Todd Murphy emphasizes that it is actually impossible to conclude anything about the existence or non-existence of God on basis of these experiments. He however claims that evolution would have developed for brain the ability to produce visions of God which often accompany near death experiences and make it easier to accept the unavoidability of the biological death. The reader can decide whether these two statements are consistent or not.
2. The general idea is that both right and left amygdala, which are the most sensitive parts of the brain because the membrane potential is nearest to the threshold for nerve pulse generation. The right hippocampus is assumed to be responsible for non-verbal, "silent" thinking and

left brain hemisphere to verbal thinking. This general picture is used by Todd Murphy to understand the conscious experiences accompanying death process about which near death experiences give a information. The experiences generated by God helmet during the first stage would be akin to the fearful emotions associated with near death experiences [J8, J4] (NDE). The experiences during the second stage bring in mind the spiritual experiences accompanying death process and having strong positive emotional coloring.

3. Persinger [J7] and Murphy [J3] propose that left amygdala is specialized to produce positive emotions (happiness, bliss, and even experience of encountering God or almost synonymously light being). Right amygdala would be specialized to produce negative emotions (such as fear and horror) and one can assign with it also depressive mood. This is not a generally accepted theory. If one accepts it, the natural question is whether right amygdala could serve as a kind of entropic dump pit and left amygdala as a highly negentropic structure. The empirical data does not force the poor right amygdala to be a whole-daily sufferer.

Consider now the explanation of the experiences induced by God helmet. The lecture by Todd Murphy (see <http://tinyurl.com/y83pq5v1>) [J3] helps considerably in attempts to understand the gist of the explanation and also helps to see its problematic aspects.

1. The selves of right and left brain fuse in some sense to form single self normally. The nerve bundles connecting the brain hemispheres allowing communications between them are essential for this integration. Right brain self is assumed to be sub-ordinate for left brain self. Magnetic pulses during the first period decompose self to two pieces: one could call them right and left self.
2. During the first stage the mental images from the right brain self become dominating and fearful experiences are due to the fact that right brain amygdala, which is specialized to produce negative emotions, is hyper-active. This phase is believed to break the connection between left and right brain hemispheres. The anecdotal evidence by Todd Murphy suggests a correlation between non-verbal mood of consciousness and negative emotions. One must be however very cautious because extreme fear and horror alone might make impossible not only verbal communication but any coherent action.
3. During the second stage both left and right brain are stimulated and expected contribute to the mental images of self when the connection between the hemispheres is intact. If I have understood correctly, the proposal is that the splitting of self to separate selves induced during the first phase is present almost permanently during the second phase and that left brain self dominates.
4. The temporary “intrusion” of the right hemisphere self to the consciousness of left brain self would give rise to visitor experience. Intrusions would mean occasional re-establishment of the connection between hemispheres. One can question the assumption that God experience and the sensed presence represent instances of the same basic experience due to the intrusion. One could also argue that sensed presence is a signal for the breakdown of the connection and is created by the realization that there is also another self using the same biological body.
5. The model of Todd Murphy for near death experiences would be that right amygdala can give rise to extremely frightening experiences but that the flow of the information to left amygdala transforms this experience to its emotional opposite. The right hippocampus suggested to be responsible for “silent” thinking would be responsible to the experiences of deep meaningfulness and of understanding. To my opinion this picture is too complex and involves too many ad hoc assumptions.

Somehow my personal feeling is that this model is not quite correct. For instance, I do not understand the meaning “intrusion” ? This could be of course be just my misunderstanding. Also the hypothesis about the specialization of left and right amygdala looks strange.

#### 4.4 The TGD Based Interpretation Of The God Helmet Experiments

To my opinion also other interpretations for the findings of Persinger can be imagined.



#### 4.4.1 Frequency modulation as a “code of consciousness”

Maxwell’s electrodynamics would suggest that a superposition of endogenous and external magnetic fields takes place in God helmet experiments and is partially responsible for the effects. This is clear from the fact that quite specific magnetic stimulation is used (signals derived from EEG during the second stage). In TGD framework one should be able to interpret this.

1. In TGD Universe endogenous magnetic fields could form a fractal hierarchy: flux quanta inside flux quanta. Several critical values of magnetic field expected. Flux quanta could be flux tubes or sheets (DNA strands could be traversed by flux sheets and one could have hierarchy of genomes making possible collective gene expression at various levels).
2. There is a hierarchy of Planck constants so that one can assign to the cell membrane potential a Josephson frequency proportional to  $1/\hbar$  and to cyclotron frequencies photon energy proportional to  $\hbar$  [K4].
3. The code for the communications from biological body to various levels of the magnetic body relies on the modulation of the Josephson frequencies assignable to the cell membrane. Assuming that the value of Planck constant is integer multiple of its standard value these frequencies span an enormous range. In the case of EEG the Planck constant is of order  $10^{13}$  in order for photons with the energy of visible photon to have frequency about 10 Hz. Since Josephson frequency is proportional to the membrane potential, the modulations of the membrane potential induce modulations of Josephson frequency so that the signal sent to the magnetic body is modulated and this frequency modulation must define the “code of consciousness”.
4. The frequencies involved with these communications are sums of harmonics of Josephson frequency and cyclotron frequency and also cyclotron frequencies can be modulated by modulating magnetic fields. The simplest possibility is that the external magnetic field induces modulation of the magnetic field. This modulation is small since the field strength is of order .01 Gauss and by a factor 1/20 smaller than the endogenous magnetic field  $B_{end} = .2$  Gauss suggested by the effects of ELF em fields on vertebrate brain. Of course also other field values are expected to be present.

#### 4.4.2 The basic philosophy behind the TGD based model

The basic philosophy behind the TGD based explanation of God helmet experiences differs in many respects from that behind the model of Persinger and Murphy. Therefore it is good to describe this philosophy first.

1. In the normal social consciousness based strongly on verbal communications the left brain self dominates and social interactions actually split the left brain self from right brain self so that right brain self remains a silent companion unable to express itself except through intuitions. This raises some questions.

Could just the need to communicate the experience verbally automatically project “me” to left brain me and cut it from “right brain self” so that only the memories of left brain self are communicated. What would happen if the subject person would communicate with external world by singing? Often persons who have lost their ability to speak and comprehend spoken language can communicate by singing. Would the the projection occur to left brain self and could the memories be different?

2. Persinger and Murphy seem to assume that right brain is God from the perspective of the left brain. Magnetic body is responsible for the third person aspect of consciousness and also for the ability to see the dying biological body from the bird’s eye perspective during OBEs accompanying also NDEs, which accordingly to Murphy could be quite real. There is indeed evidence that a subject person unable to move from bed has been able to see objects which she should not have been able to see. If magnetic body is real it could also receive extra-sensory information.

Could the magnetic body of right brain or of the entire brain be in some sense the God from the view point of the brain? The TGD based interpretation (see <http://tinyurl.com/y7qfgcbx>) for the vision of Jaynes about bicameral consciousness as a predecessor of modern consciousness [J6] citeallbsemitrance would conform with this. The God of old testament would be the personal magnetic body which would not have yet become a highly integrated part of self and could be experienced as an outsider. Jaynes also proposes that the consciousness of schizophrenic is much like bicameral consciousness.

3. It is not necessary to assume that the right amygdala is specialized to produce negatively colored motions and left amygdala positive emotions. Same applies also to the proposed roles of right and left hippocampi. In fact, according to Wikipedia article about lateralization of brain function (see <http://tinyurl.com/ye2os3>) depression is linked with hyperactive right hemisphere and selective involvement in “processing negative emotions, pessimistic thoughts and non-constructive thinking styles”. A relatively hypoactive left hemisphere is said to be “specifically involved in processing pleasurable experiences” and “relatively more involved in decision-making processes”. One can interpret this in many ways. The hyper-activity of right hemisphere could tend to cut its connection with its magnetic body and cause a depressive mood.

Intense nerve pulse activity could cause this if nerve pulse generation breaks coherence of the EEG oscillation due to the oscillating membrane potentials inducing generation of signals to the magnetic body. The reduced neural activity of left hemisphere would mean a better connection to the magnetic flux tube and positive emotional coloring.

4. Note that this picture conforms with spiritual practices which teach that the manner to achieve piece of mind and bliss is to stop thinking, which indeed means reduce neural activity and more stable connection to the magnetic body. If one takes this conceptualization seriously, one could conclude that the modern hectic society tends to split the connections to the personal magnetic bodies. Since they represent higher levels in the hierarchy of conscious entities, this would lead to a loss of spirituality and also social regression if magnetic bodies are responsible for social structures and cultural evolution.
5. For about 26 years ago I had also a long-lasting “enlightenment” experience - actually two of them. The general structure of these experiences fits with thde proposed general format. The first experience began with the experience of getting in contact with what I spontaneously called Great Mind. I started to make all kinds of questions which I imagined of writing to a monitor that I saw in front of me. Later I realized that the writing was not necessary. I also realized that our communication was severely estricted by the fact that my language did not yet have words for to express the messages of this Great Mind so that the messages contained a lot of “blancos”. I had an experience of understanding but did not know what I understand. I also felt that everything around me has extremely deep meaning. One of the first questions I did was “How long I will live?”. From the humorous reply expressed as an endless rapid running of a counter containing a long sequence of digits I understood that there is no death. I also asked “Am I alone in this Universe?”. The reply was enigmatic “You are a God!”. Later it somehow became clear that this God like entity was actually in some sense me. A possible interpretation could be that a new higher layer to the hierarchy of layers of my personal magnetic body had emerged as this God like creature became a part of my personal magnetic body. Much later I realized that this paradoxical realization was the analog for Brahman=Atman identity of Eastern philosophies.

Consider now the more technical assumptions.

1. One can assume that right and left brain selves can entangle to form a single self and that magnetic flux tubes between brain hemispheres closely associated with the connecting nerve bundles serve as a correlate for this entanglement. In TGD framework the notion of negentropic entanglement (see **Fig.** <http://tgdtheory.fi/appfigures/cat.jpg> or **Fig. ??** in the appendix of this book) makes sense and means entanglement entropy defined number theoretically is negative rather than being positive as usually. Negentropy Maximization Principle for quantum jumps guarantees the stability of negentropic entanglement. Entanglement probabilities must be rational or at most algebraic numbers or negentropic entanglement.

2. The basic mechanism would be reconnection of magnetic flux tubes. Typically two parallel connecting flux tubes would touch each other and reconnect to form U-shaped flux tubes representing flux tubes beginning and returning to left (right magnetic body). What is the role of the external magnetic field in this process? Could the closed flux tubes of the external magnetic fields reconnect with those connecting the right hemisphere to left hemisphere. Suppose that magnetic flux tubes indeed serve as geometric correlates for attention interpreted as negentropic entanglement.

Could one say that the magnet creating chirp signal catches the attention of the right brain magnetic body directed to the right hemisphere? Could the splitting of the connection to the magnetic body create the negative emotions. It is enough that the magnet- magnetic body entanglement becomes entropic to destroy the entanglement in state function reduction if one believes in NMP and perhaps this occurs.

3. One can ask whether this kind of mechanism could explain also the effects of strong (or order 1 Tesla) fields on brain in transcranial magnetic stimulation (see <http://tinyurl.com/s4aw7>) or is the standard explanation in terms of eddy currents inducing nerve pulse patterns enough to explain the effects.

#### 4.4.3 The model for God helmet experiences

Consider now a the general TGD inspired model explaining God helmet experiences.

1. The magnetic chirp during the first stage tends to decouple the right hemisphere from its magnetic body and possibly also from the magnetic body of left brain. This alone creates the negatively colored emotions- kind of feeling of being abandoned by God. This could be also general mechanism of depression and the manner to cure depression would be re-establishment of this connection.

At quantum level the cutting of the magnetic connection would mean the destruction of entanglement between parts of the two brain hemispheres or between part of right hemisphere and its magnetic body temporarily. This would lead to the splitting of self to right and left brain sub-selves or the loss of the right hemisphere magnetic body entanglement.

2. If one is ready to take seriously the notion of number theoretic entropy [K8], the minimum condition would be that the magnetic chirp causes the entanglement probabilities become non-rational or even non-algebraic numbers so that the number theoretic entropy does not make sense. Ordinary entanglement entropy is always non-negative and state function reduction reduces the entanglement and self splits to two.
3. During the second stage the simultaneous activation of both hemispheres by artificial neuronal signals derived from the EEG of amygdala and hippocampus would fuse both hemispheres to single coherent unit so that the mental images of the right hemisphere would contribute to the conscious experience. The coherence could increase from what it is during ordinary wake-up consciousness dominated by verbal communications. "Being nearer to God" alone could give rise to highly positively colored emotions and to a direct experience of seeing the God/light being/magnetic body and explain the experience of meaningfulness and deep understanding without being able to express what one understands. This inability could be simply to the lack of appropriate language. There is no need to assign this experience to the right hippocampus.

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