

# Magnetospheric Sensory Representations

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### Abstract

One can imagine two basic candidates for how “our” sensory and motor control are realized: the representations at the personal magnetic sensory body and the representations on the magnetic flux tubes structures of Earth, the magnetic body of Mother Gaia. Quite a long time I saw the problem as the question “Which of these options is correct?”

If our sensory and motor representations were realized using magnetospheric representations alone, the consciousness of astronauts would differ in a dramatic manner from the ordinary wake-up consciousness. This is not the case so that personal magnetic bodies must give the basic contribution to our personal sensory representations and motor control if the basic approach is correct. Because of the sharing of mental images also the sensory and motor areas of the magnetic Mother Gaia making possible higher collective levels of consciousness should be however important for us and perhaps responsible for memory and imagination. Therefore is of importance to try to get some idea also about the magnetospheric representations.

1. The basic element hypothesis is that some kind of resonance mechanism is involved. The simplest possibility is that projector MEs (“massless extremals topological counterparts of light rays” to the sensory canvas have length equal to the wavelength defined by the magnetic transition frequency. Also the TGD counterpart of Alfvén resonance (magnetic flux tube as string) might be involved. In the simplest situation the length of the projector ME would be equal to the distance to the activated point of the magnetic flux tube structure involved. Also the intersections of the projector ME with magnetic flux tubes of Earth and some cavity resonance at larger space-time sheet, such as Schumann resonance, could help to amplify the signal. Representations which do not satisfy this condition could of course contribute to our consciousness but the contribution should be weak and masked by resonant contributions.

The resonance idea has gained strong support from much later developments and a concretized realization in terms of cyclotron frequencies and generalized Josephson frequencies has been proposed leading also to a concrete model for EEG as communications to the personal magnetic body.

“Personal” sensory and motor representations are realized at the personal magnetic flux tube structures by place coding: if the thickness of the magnetic flux tube increases linearly with the length coordinate of the flux tube resonance condition is satisfied all along it. A similar dependence is implied also by the homeopathic findings and by the requirement that magnetic energy density per unit length is constant.

3. Magnetospheric sensory and motor representations are realized at the magnetic body of Earth and correspond the personal consciousness of Mother Gaia. Also we can share part of her experience by fusion of the mental images. Magnetospheric representations could be responsible for the transpersonal and third person components of our consciousness, and also for memories and even imagination. The weakening of Earth’s magnetic field provides the fundamental distance coding via cyclotron frequency scale, which scales with distance as  $1/r^3$  in the dipole approximation holding for small distances but differs radically from this behavior at large distances, in particular inside magnetic tail. In magnetospheric case resonance condition gives strong conditions on the representation and can be satisfied only inside plasma sphere.
4. There seems to be no upper bound for the size of the super-conducting magnetic web providing the realization for the self hierarchy, and one can build precise quantitative models for this hierarchy. For a Buddhist this vision does not come as a surprise but challenges all cherished beliefs of brain scientist.

In this chapter this vision is developed quantitatively. The vision about magnetosphere as a living organism allows to develop the view about sensory representations to a rather detailed level. The intriguing observation that brain dynamics and iono- and magnetospheric physics seem to have common characteristic time scales, can be understood in this framework and even the mysterious 5 second time scale associated with Comorosan effect finds a possible explanation.

As I wrote the first version of the chapter I was still at temporal distance of 10 years from the ideas that TGD would give rise to a hierarchy of Planck constants defining dark matter hierarchy and that flux tubes of magnetic bodies carrying monopole flux would be also carriers of dark matter. These new ideas make the view about magnetosphere as conscious entity more precise: it is dark part of the magnetosphere which can be seen as conscious entity.

A TGD based view about magnetosphere - or rather dark part of it (!) - results as a by product and allows to topologize the phenomenological but overall important notions of

magnetohydrodynamics. In magnetohydrodynamics magnetic field lines are treated as effective super-conductors: in TGD Universe magnetic flux tubes *are* super-conductors. Also Alfvén waves cease to be a phenomenological concept, and the super-conducting geodynamo model is free of the difficulties of the standard model.

## 1 Introduction

The general view about sensory and motor representations has been rather heuristic hitherto. By some additional thought one can however build a more detailed picture about sensory and motor representations.

### 1.1 Are Sensory Representations At The Personal Magnetic Body Or At The Magnetic Body Of The Earth's Magnetic Field?

One can imagine two basic candidates for how *our* sensory and motor control are realized: the representations at the personal magnetic sensory body and the representations on the magnetic flux tube structures of Earth, the magnetic body of Mother Gaia. Quite a long time I saw the problem as the question “Which of these options is correct?”.

If our sensory and motor representations were realized using magnetospheric representations alone, the consciousness of astronauts would differ in a dramatic way from the ordinary wake-up consciousness. This is not the case so that personal magnetic bodies must give the basic contribution to our personal sensory representations and motor control if the basic approach is correct. Because of the sharing of mental images also the sensory and motor areas of the magnetic Mother Gaia making possible higher collective levels of consciousness are however important for us and are perhaps partially responsible for memory and imagination and third person aspect of our consciousness. Therefore it is of importance to try to define and understand also the magnetospheric representations.

1. The basic hypothesis is that some kind of resonance mechanism is involved. The simplest possibility is that projector MEs (“massless extremals”, topological counterparts of light rays) to the sensory canvas have length equal to the wavelength defined by the magnetic transition frequency. Also the TGD counterpart of Alfvén resonance (magnetic flux tube as string) might be involved. In the simplest situation the length of the projector ME would be equal to the distance to the activated point of the magnetic flux tube structure involved. Also the intersections of the projector ME with magnetic flux tubes of Earth and some cavity resonance at larger space-time sheet, such as Schumann resonance, could help to amplify the signal. Representations which do not satisfy this condition could of course contribute to our consciousness but the contribution should be weak and masked by resonant contributions.
2. What might be called personal sensory and motor representations are realized at the personal magnetic flux tube structures by place coding: if the transversal area of the magnetic flux tube increases linearly with the length coordinate of the flux tube, the resonance condition is satisfied all along it. A similar dependence is implied also by the homeopathic findings [I1] discussed in [K12] and by the requirement that magnetic energy density per unit length is constant.
3. Magnetospheric sensory and motor representations are realized at the magnetic body of Earth and correspond to the personal consciousness of Mother Gaia. Also we can share part of her experience by fusion of the mental images and magnetospheric representations could be responsible for the transpersonal and third person components of our consciousness, and also involved with our memories and imagination. The weakening of Earth's magnetic field provides the fundamental distance coding via cyclotron frequency scale, which scales with distance as  $1/r^3$  in the dipole approximation holding for small distances but differs radically from this behavior at large distances, in particular inside magnetic tail. In the magnetospheric case resonance condition gives strong conditions on the representation.
4. There seems to be no upper bound for the size of the super-conducting magnetic web providing the realization for the self hierarchy and one can build precise quantitative models

for this hierarchy. For Buddhist this vision does not come as a surprise but challenges the cherished beliefs of brain scientist.

## 1.2 The Relationship Between Earth's Magnetic Field And Personal Magnetic Body

A dramatic clarification to the relationship between personal magnetic body and Earth's magnetic field came through a rather frustrating experience. 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.

The understanding of the dark matter hierarchy leads to a detailed quantitative view about quantum biology with several testable predictions [K10]. 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  $p = 2^{127-1}$ ,  $k = 0, 1, 2, \dots$  [K10]. 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  $\lambda$  [K11] as  $\lambda = n$  where  $n$  characterizes the quantum phase  $q = exp(i\pi/n)$  characterizing Jones inclusion [K39]. The values of  $n$  for which quantum phase is expressible in terms of squared roots 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  $r = 18 \mu m$ , 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 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 [K2].

This picture inspires several questions. Is the Earth's magnetic field at  $k = 169$  flux sheets accompanied by  $n = 5$  dark variant at which macroscopic quantum phases responsible for many properties of living matter reside. How strongly the behavior of  $B_{end}$  correlates with that of  $B_E$ ? For instance, do perturbations of  $B_E$  induce those of  $B_{end}$  and is the average ratio  $B_{end}/B_E$  constant? Unfortunately, I did not have a slightest idea about these questions when I wrote the first version of this chapter and the implications of the new view about  $B_{end}$  and its relationship to  $B_E$  are not discussed in the sequel.

## 1.3 Topics Of The Chapter

In this chapter the transpersonal, magnetospheric sensory and motor representations are the principal objects of interest.

1. The basic vision inspired by fractality of consciousness is that the entire solar system is a gigantic magnetic organism having planetary magnetospheres as sub-organisms. Magnetospheres represent collective levels of consciousness and receive sensory input from biosphere and perform also very high level bio-control. Like brain, also magnetosphere decomposes to two kinds of regions. Relatively stable regions are optimal for the sensory representations.

Unstable and self-organizing transition regions are optimal for imagination and for a generalized motor control in the planetary scale. Motor control could mean higher control at biochemistry level but also social behavior could reflect the presence of this kind of control since we are in a well defined sense cells (or perhaps neurons) of the magnetic Mother Gaia.

2. The structure of the magnetosphere predicts a hierarchy of magnetospheric selves bringing in mind the chakra hierarchy of Eastern philosophies of consciousness. This hierarchy has counterpart at the level of brain and corresponds to the 5-levelled hierarchy of cortex plus midbrain and brain stem.
3. The resonance condition  $f_m = c/L$  relating magnetic frequency to the length of the projector ME, is very natural for the magnetospheric sensory representations. The condition can be satisfied only within the plasma sphere and for EEG frequencies above 8.6 Hz. Also cavity resonances associated with various space-time sheets (inner core of Earth, the cavity below ionosphere, magnetosphere,...) could give could be behind resonance frequencies. The predictions are consistent with the basic facts about EEG.
4. The mysterious  $\tau_C = 5$  second time scale associated with the Comorosan effect (the enhancing effect of the laser light irradiation on the catalyst activity when irradiation time is a multiple of 5 seconds) corresponds to several magnetic transition frequencies in  $\sim 10$  nT magnetic field prevailing at plasma sheet. This kind of magnetic field is created also by magnetic particles in lungs. This inspires the speculation that very high level electromagnetic bio-control from, say plasma sheet and magnetic lobes is present.

A TGD based view about magnetosphere results as a by product and allows to topologize the phenomenological but overall important notions of magnetohydrodynamics. In magnetohydrodynamics magnetic field lines are treated as effective super-conductors: in TGD framework magnetic field lines are replaced by magnetic flux tubes which could be genuine super-conductors (here the value of Planck constant is expected to play the key role). Also Alfvén waves cease to be a phenomenological concept, and the super-conducting geodynamo model is free of the difficulties of the standard model.

What makes the proposed speculative picture so fascinating its its generality. Even meteors have magnetospheres so that the generation of conscious life would be completely universal phenomenon unavoidable for any magnetized objects in the vicinity of any star producing ionic wind! The crucial prediction is that magnetospheres are living, self-organizing systems. There is indeed empirical support for this prediction.

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

## 2 The Structure Of Magnetic Field Of Earth And Variation Of Cyclotron Frequency Scales

It is interesting to try to relate the model for sensory representations to the structure of Earth's magnetosphere. To achieve this, I will provide a brief novice's overview about the structure of magnetosphere. I will use partially TGD based language in which magnetic field lines are replaced by magnetic flux tubes and the formation of the plasma corresponds to the leakage of the supra currents from the magnetic flux tubes. I will also briefly consider TGD based qualitative models for the phenomena, many of which are not well understood in Maxwellian theory. Examples of such phenomena are Alfvén waves which are not proven to result from Maxwellian theory, and magnetic dynamo of Earth whose working mechanism is not really understood. Also the mechanism of auroras becomes very concrete when field lines are replaced with flux tubes [K7].

### 2.1 Magnetosphere

Solar wind [F4, F19, F18] determines the large scale structure of the magnetic field of Earth to a high extent. The basic structural components are transition regions and regions between them.



1. At the bow shock the solar wind arriving at a supersonic velocity of 500 km/s encounters Earth's magnetic field and is transformed to a subsonic flow and dissipates energy inside magnetosheath where the plasma is denser and hotter than in the solar wind. The distance of the bow shock is roughly 12-14  $R$  ( $R$  denotes Earth's radius).
2. The shocked solar wind cannot penetrate Earth's magnetic field and a cavity called magnetosphere is formed. Interplanetary magnetic field and magnetosphere is separated by a transition region called magneto-pause, which is accompanied by a plasma mantle. At the day side magneto-pause is at distance of about 10  $R$  but when solar wind is particularly strong it can move down to 6-7  $R$ . At the night side magnetosphere is stretched into long cylindrical magneto-tail of length about 1000  $R$  and radius about 20  $R$ .

Magnetosphere consists of clearly separated regions with widely different densities and temperatures. The main division is into inner and outer magnetosphere. In the inner magnetosphere magnetic field lines are co-rotating with the Earth: in the outer magnetosphere they are stationary. Magneto-pause contains an ionic current determined by the discontinuity of the magnetic field and orthogonal to it.

### 2.1.1 Magnetic lobes

The outer magnetosphere at the night side, magneto-tail, consist of northern and southern magnetic lobes which are cavities having very low ionic density of about .01 ions per cubic cm. The low density can be understood as resulting from the absence of the solar wind in this region. By Maxwell's equations magnetic field is approximately constant in the region where the flow lines are parallel (if sources can be neglected). According to [F3] the value of the magnetic field is about 30 nT in the interior of the lobes. The relatively strong magnetic field inside lobes serves as a magnetic energy battery feeding energy to the plasma sheet.

Magneto-tail is a cylindrical structure with radius of order  $R_m = 20R$ . Magnetic lobes extend up to  $r \sim 1000R$ . The magnetic field lines remain actually closed. In TGD framework this means the existence of a closed supra-current circuitry formed by the magnetic flux tubes.

### 2.1.2 Plasma sheet and magneto-pauses

Magnetic lobes are separated by a plasma sheet in the equatorial plane consisting of hot ( $5 \times 10^6$  K), low density plasma (.3-.5 ions/cm<sup>3</sup> as opposed to .01 ions/cm<sup>3</sup> inside lobes) with magnetic field  $\sim 10$  nT. Plasma sheet extends from  $8R$  to about  $60R$  and has thickness of order few  $R$ , and gets thinner with increasing distance. Plasma sheet disappears at so called neutral point, where magnetic field vanishes. In the plasma sheet the magnetic flux from southern lobe flows to the northern lobe. Near the Earth plasma sheet reaches the high latitude auroral ionosphere. The value of the magnetic field immediately above the magnetic sheet is 20 nT.

In TGD framework the plasma sheet can be seen as resulting from the leakage of the supra currents from the magnetic flux tubes of Earth's magnetic field to a larger space-time sheet. This supra-current leakage is caused by the inertia of the ions and electrons in the region where the magnetic flux tubes are highly curved. The leakage occurs also in the magneto-pause, where the tangential component of the magnetic field is discontinuous and a surface current orthogonal to  $B$  generating the discontinuity flows. In the magneto-pause the magnetic flux tubes of the inner and outer region are parallel. The reconnection of the parallel flux tubes of the magnetic fields of Earth and Sun allows the transfer of the ions of the solar wind to the magnetosphere. Magneto-pause is accompanied by a plasma mantle, which could be partially due to the leakage of ions to larger space-time sheet accompanying the reconnection process.

There is a convective flow of ions towards the plasma sphere along the plasma sheet. In TGD framework this motion must take place at a larger space-time sheet or involve a hopping between magnetic flux tubes: in both cases a breaking of super-conductivity is implied.

Plasma sheet has also a boundary layer in which the tangential component of the magnetic field is discontinuous. This requires a surface current orthogonal to the axis of the sheet. This current results when the ions from the magnetic flux tubes leak out from flux tubes to a larger space-time sheet by their inertia in the highly curved portion of the flux tube caused by the tangential discontinuity.

### 2.1.3 Cusps

Southern and northern cusps are funnel-shaped regions which on the day side consist of closed highly compressed flux tubes of dipole field and on the night side of almost open flux tubes stretched deep into the magnetospheric tail. In this funnel magnetic field is orthogonal to the magneto-pause and the magnetic flux tubes of the solar magnetic field can penetrate the magnetosphere. This implies that solar plasma contained in the solar magnetic field lines penetrates deeply into the magneto-tail by reconnecting with the field lines of Earth's magnetic field near poles. This gives rise to auroras [F20].

Reconnection can be seen as resulting from the penetration of the solar magnetic flux tubes at the upper boundary of the magneto-pause along the plasma sheet to a highly stretched flux tubes along the boundary of the plasma sheet. The transformation to open flux tubes can happen only if the solar flux tubes reconnect with the flux tubes of the solar magnetic field penetrated into the plasma sphere. Thus auroras can be seen as a phenomenon involved with the boundary between plasma sheet and lobes.

Cusps, and to some extent also plasma mantle, serve as a channel along which the solar wind feeds "magnetometabolic" energy to the magnetosphere needed to run the geodynamo system [F1] (the notion of super-conducting geodynamo will be introduced later). The dipole field generated solely by the convective currents in Earth interior would die out in few thousands of years. The field inside lobes serves as a storage of magnetic energy and is recharged by the energy of the solar ions leaking into the magnetic tail in the reconnection process. One could see the cusps also as a communication channel between solar and Earth's magnetic structures, kind of magnetic "ears" of magnetic Mother Gaia.

### 2.1.4 Inner magnetosphere

Inner magnetosphere is a toruslike structure whose extension varies between  $4R$  (day side) and  $8R$  (night side). In the inner magnetosphere the typical density is about 1 ion per cubic centimeter. Inner magnetosphere is bounded by a transition layer of thickness of  $\sim R$  (magneto-pause). In this region the density of the ions drops rapidly.

Inner magnetosphere contains plasma sphere whose radius varies in the range  $2R$ - $4R$  at day side and  $2R$ - $6R$  at night side. Plasma has an ionospheric origin. The density of the cold plasma consisting mainly of protons ( $T \sim 1$  eV) sphere varies in the range  $10 - 10^3$  ions/cm<sup>3</sup>, whereas the temperature is  $\sim 5 \times 10^3$  K. The cold, dense plasma of plasma sphere is frozen around magnetic flux lines which co-rotate with Earth. In TGD framework this means that flux tubes co-rotate and thus change shape. In the equatorial plane the density of the plasma sphere drops sharply down to  $\sim 1$  ion/cm<sup>3</sup> at  $r = 4R$ . This transition region is known as a plasma pause. During magnetic storms the outer radius decreases since the pressure of the solar wind compresses the plasma sphere. The day-night variation of the shape of the plasma sphere is rather small. Within this region the magnetic field has in a reasonable approximation dipole shape with radiation belts forming an exception.

### 2.1.5 Radiation belts and ring currents

Plasma sphere contains the inner and outer van Allen radiation belts [F2] (extending from  $2R$  to  $4R$  at the day side and from  $2R$  to  $9R$  at the night side). Both the inner and outer belts extend up to latitude of 60 degrees. The boundaries of the belts follow magnetic field lines except in at the Northern and Southern tips. This region contains ring currents.

One of the functions of the radiation belts is to prevent the penetration of the biologically harmful high energy cosmic rays to the ionosphere. In fact, the inner protonic belt results by the decay of the cosmic ray neutrons to protons. Second function (in TGD universe!) is to act as a part of a controlled dynamo system giving rise to the magnetosphere of Earth (for the standard theory of geodynamo see [F1]).

It has been found that the energies of the ions in the radiation belts are much higher than one might expect [F5]. This might be understood if part of the ions runs as supra currents along the magnetic flux tubes. Super-conductivity is broken only by the leakage of the supra currents from the magnetic flux tubes. This could explain the success of magnetohydrodynamics based on the assumption of effective super conductivity.

### 1. Inner radiation belts

There are actually two separate inner radiation belts: the one containing protons and the one containing electrons. Protons in the inner belt have energies in 10-100 MeV range and readily penetrate space crafts. The inner radiation belts are concentrated around equator in the range  $(1.1-3.3)R$  (these numbers depend on the conventions used and should not be taken too literally). In the protonic belt the maximum of the flux density is at  $2R$ : in electronic belt the maximum flux density is at about  $1.4R$ . The inner belts are relatively stable and there is no night-day difference. The inner belts feel magnetic storms and vary with the 11 year period of solar activity.

What is interesting is that the inner belts are also sensitive to human technology. The inner belt has lowered above the East Coast of US from 300 km to 10 km [J1]: this process is associated with power transmission along magnetic field line and the usage of the ionosphere-resonance frequency 60 Hz as the frequency of household current.

During the last decade two new belts have formed inside inner belts [F4], [J1]. The new electronic belt has maximum electron flux at  $r \sim 2R$  (earlier flux maximum was at  $r \sim 1.4R$ ). The second newcomer consists mostly of  $O^+$  ions but containing also  $He^+$ . This process has been seen as a part of magnetic re-self-organization process occurring in the scale of the entire helio-magnetosphere implying rapid changes of planetary magnetospheres [J1].

### 2. Outer radiation belt

Outer belt contains mainly electrons with energies up to 10 MeV and is produced by the injection of charged particles during geomagnetic storms. This makes outer belt much more dynamical than the inner one. The cross section of the outer radiation belt is banana shaped. The outer belt ranges from  $3R$  to  $6R$  (at night side). The maximum for the density of electrons above MeV energy occurs at  $4R$ .

### 3. Ring currents

Radiation belts contain ring currents. Electronic ring current rotates in the same direction as Earth whereas protonic current runs to the opposite direction. In the outer belt only electronic current is present. Quiet time ring current in the inner electronic *resp.* protonic belts consists mainly of hydrogen ions *resp.* electrons but during magnetic storms also  $O^+$  ions are present (note however the presence of the new  $O^+$  belt). Ring current has the effect that magnetic field gets stronger at the outer side of given belt and weaker at the inner side.

#### 2.1.6 Super-conducting geodynamo?

The standard theory for Earth's magnetic field assumes that the convective currents in the liquid outer core of Earth generate the magnetic field [F1]. It has been found that also planets which do not possess liquid core can have magnetic field: this means a failure of the standard geodynamo theory. Furthermore, planetary magnetospheres have very similar structure [F15], and solar magnetosphere has "memory" [E2]. This suggests that magnetospheres are self-organizing systems having only few asymptotic patterns. There is evidence that the changes of Earth's magnetic field can be quite too fast (several degrees per day!) to be caused by convective currents in the outer liquid core [F9]. Also the different orientations of the magnetic and rotational axis is not what one would make as the first guess. This forces to think that standard dynamo theory might be somehow wrong.

The vision about solar and planetary magnetospheres as self-organizing systems inspires the idea that the rotational electric field and ring currents could be an essential part of the dynamo system generating, and perhaps even controlling, Earth's magnetic field. Solar wind would provide the energy needed for this purpose. This vision gets support from the findings of the last decades about dramatic changes in the magnetospheres of some planets [J1] (auroras in Saturn, polar shifts of Uranus and Neptune, the doubling of the field intensity of Jupiter, rapid pole shifts of the geomagnetic field suggesting the possibility of a geomagnetic field inversion in progress, significant growth of the recognized geomagnetic anomalies). That solar magnetic activity has been also especially strong during this time supports the view that solar wind controls these events to some extent.

### 1. Super-conducting geodynamo model

The notion of many-sheeted space-time (see **Fig.** <http://tgdtheory.fi/appfigures/manysheeted.jpg> or **Fig. 9** in the appendix of this book) leads to a modification of the dynamo theory.

1. The simplest TGD based model for a rotating astrophysical object predicts dynamo system replacing black hole type solutions with singularity free space-time surfaces [K37]. The basic characteristic of the models is the presence of the orthogonal magnetic and electric fields (this follows from the assumption that  $CP_2$  projection of the space-time surface is 2-dimensional).
2. The fields in question can be either magnetic or  $Z^0$  magnetic. In the TGD framework ring currents consist of the ions “dropped” from the magnetic flux tubes to a larger space-time sheet. The dropped ions drift in an electric field whose field lines circle around the axis of the magnetic field. Ring currents generate a weak magnetic field in a direction orthogonal to the plane of the ring currents. This field, if sufficiently strong, could serve as a seed inducing a spontaneous magnetization inside Earth’s outer or inner core. In standard physics this is not possible since Earth’s core is very hot so that conductive currents as a source of the magnetic field are the only possibility.
3. In TGD the situation is different. The interior of Earth contains besides atomic space-time sheet also super-conducting space-time sheets at very low temperature. In particular, the flux tubes of the magnetic fields generated by the ring currents are present. Since the temperature is extremely low, electrons could bind to Cooper pairs with net spin  $J = 2$  (ions would possess relative angular momentum) as in high  $T_c$  super-conductors [K6, K7]. Bosonic ions could form Bose-Einstein condensates. Exchange interaction favors magnetization parallel to the seed field. This generates additional magnetic field in the direction of the magnetic field inside flux tubes and leads to spontaneous magnetization and the amplification of the seed field. The same trick could be applied also by living organisms to achieve magnetic homeostasis.
4. The energy needed to maintain the magnetic field would be much smaller than in the conventional dynamo model since dissipative effects are small. The direction of the magnetic field could also vary rapidly for the same reason. To some degree the direction of the magnetic field could be controlled by the solar wind since it affects ring currents. An interesting question is whether the solar wind could feed electrons to the Earth’s interior: first to the magnetic flux tubes of Earth’s magnetic field in a reconnection process, and then to Earth’s core along flux tubes in the outer radiation belt dipping near to the polar caps.
5. Only the magnetic flux tube structure containing the super-conducting matter rotates around the magnetic axis. The small amount of super-conducting matter means that the change of the direction for the magnetic field does not require huge energy and angular momentum transfers. The rotation axis of the space-time sheet representing entire Earth could be different. There could be similar dynamo also at this larger space-time sheet. In the simplest model this dynamo would be  $Z^0$ -magnetic.
6. The mechanism inducing the reversals of the magnetic field is at the topological level the same as in the standard model of geodynamo (for an early TGD inspired model of the solar sunspot cycle see [K32] ). Magnetic flux tubes get strongly entangled during differential rotation and sooner or later this leads to a reconnection process. Super-conductivity makes possible very rapid reversals.
7. What distinguishes TGD model from geodynamo model is that the super-conducting magnetic flux tubes are the primary dynamical system rather than the convective currents. This allows to view the anomalies of the geomagnetic field as additional magnetic flux tube bundles (there are four anomalous regions: Canadian, East Siberian, Brazilian, and Antarctic) having some role in the control of the magnetodynamics. For instance, the feed of super-conducting electronic or ionic Cooper pairs to the Earth interior would allow to intensify magnetization inside flux tubes. Self-organization would explain why the magnetic field patterns are similar for all planets possessing a detectable magnetic field. Self-organization would also explain the “memory” of the solar magnetic field [E2].

2. *Dark matter as a hierarchy of phases with large values of Planck constant*

In the original model it was assumed that space-time sheets carrying various Bose-Einstein condensates are at a very low temperature so that cyclotron energy scale is above thermal energy and spontaneous magnetization as a source of magnetic field becomes possible instead of electric currents.

The hypothesis that dark matter corresponds to a hierarchy of phases with a large value of Planck constant [K11] brings a new element to the model since magnetic interaction energies scale as  $\hbar$  and for large enough value of  $\hbar$  can be above thermal threshold. Also dissipation rates are expected to behave like  $1/\hbar$  and would thus be very small for large values of Planck constant.

Therefore macroscopically quantum coherent dark matter can generate spontaneous magnetization even of magnetic flux sheets are at the same temperature as the visible matter. The TGD inspired model of [J2] [K10] relies on a hierarchy for favored values of Planck constant given by  $\hbar(k) = \lambda^k \hbar_0$ ,  $\lambda = 2^{11}$ .  $\lambda = 2^{11}$  corresponds to a fundamental constant in TGD Universe [K32]. For  $k \geq 4$  cyclotron energy for ions is above the thermal threshold at room temperature. For electrons this is true already for  $k \geq 3$ . At least the values of  $k$  satisfying  $k \leq 7$  are favored by the model for EEG predicting a fractal hierarchy of EEGs.

### 3. Application to planetary magnetospheres

Consider now how the proposed model survives qualitative tests.

1. Five planets (Earth, Jupiter, Saturn, Neptune, and Uranus) have detectable magnetic fields. The rings of Saturn are an excellent candidate for the seed of the magnetic field. Also Jupiter has a dense ring of condensed plasma rotating at its radiation belts.
2. Mercury is smallest of the terrestrial planets and rotates slowly (rotation period is 58.6 days) but has weak magnetic field contrary to what the standard dynamo theory predicts [F15]. Mercury is also the planet nearest to the sun and solar wind is strong at this distance. This could mean that the ring currents are sufficiently intense to generate the critical seed field inducing the spontaneous magnetization.
3. Mars has extremely weak magnetic field. Magnetic field is crucial for life in TGD framework and there is evidence that Mars has possessed life in past. It would be interesting to find whether Mars has had magnetic field in the past. Earth's magnetic field should vanish during two millenia if it continues to decay with the recent rate. Those who like doomsday scenarios could of course wonder whether the life in Earth might suffer the Martian fate and how much time our species still has?
4. Also Venus has very tiny magnetic field. It has almost same radius as Earth and is also hot. The rotation period is however very long (243 days) and in the standard model this is taken as an explanation for the smallness of the magnetic field. In TGD framework one must assume that the rotation velocities of the ions of the ring currents are proportional to the rotation velocity implying that the seed magnetic field is below the critical value.

#### 2.1.7 Magnetic transition frequencies in magnetic lobes and plasma sheet

The values of important magnetic transitions frequencies in various regions of the magnetosphere are crucial if one wants to construct a general vision about sensory and motor representations at the magnetic sensory canvas. In the inner magnetosphere dipole approximation allows to estimate the spatial dependence magnetic transition frequencies.

In magnetosheath and magnetolobes the average values of the magnetic field are 10 nT and 30 nT respectively. Immediately above the magnetosheath the value of the magnetic field is 20 nT. Magnetosheath could thus allow place coding by the magnetic transition frequency scale whereas magnetolobes are not tailor made for this purpose. Note that the thickness of the magnetic flux tubes in the field of 10 nT =  $2^{-9} B_e$ ,  $B_e = 5 \times 10^4$  nT is from the quantization of magnetic flux equal to about 55  $\mu\text{m}$  and thus corresponds to a biological length scale. This length scale corresponds to the p-adic length scale  $L(11, 16)$  ( $L_p(n) = p^{(n-1)/2} L_p$ ). Already this encourages to think that plasma sheet might be involved with bio-control.

The strength of the interplanetary magnetic field depends on the intensity of solar wind and varies between .2 – 80 nT and has average of 6 nT. Interestingly, the maximum value 80 nT corresponds to the p-adic length scale  $L(173) = 20 \mu\text{m}$ .

### 1. Proton

In the case of proton there are three especially interesting frequencies to be considered: cyclotron frequency  $f_c = eB/2\pi m_p$ , spin flip frequency and the frequency of combined spin flip and  $\Delta n = 1$  transitions. The frequencies of these transitions in magnetic field of  $.5 \times 10^{-4}$  T are  $f_c = 300$  Hz,  $f_{flip} = 838$  Hz,  $f_1 = 532$  Hz and  $f_2 = 1138$  Hz. In a field of 10 nT the values of the transition periods  $T = 1/f$  are  $T_c = 16.7$  sec,  $T_{flip} = 6$  sec,  $\tau_1 = 9.3$  sec, and  $\tau_2 = 4.4$  sec. For a field of 30 nT the values are obtained by dividing by three. Plasma sheet contains also  $He^{++}$  and  $He^+$  ions and for these the cyclotron times are  $2\tau$  and  $4\tau$ . For  $O^+$  ion which is also present cyclotron time varies between 1 min 20 s and 4 minutes. All these time scales are typical time scales of human consciousness. For the interplanetary magnetic field protonic cyclotron times are 13.9 min, 27.8 sec, and 2.1 sec for the minimum, average, and maximum respectively.

### 2. Electron

For electrons the cyclotron frequency is 282 Hz for 10 nT so that electronic cyclotron transitions cannot represent ionic cyclotron transitions in brain (if they occur at the flux tubes of Earth's magnetic field!). Spin flip combined with cyclotron transition represents however an important exception. In this case the non-vanishing transition frequency is due to the anomalous magnetic moment of electron and the frequency in the reference field of  $.5 \times 10^{-4}$  T is 2255 Hz. This gives  $T(e) = 2.24$  sec. Note that also  $n = 3$  protonic cyclotron transition gives rise to nearly the same period.

It is interesting to notice that these time scales are important time scales of human consciousness and that both protonic spin flip time scale and  $T(e)$  nearly half of the 5 second time scale associated with the Comorosan effect [I8, I3] discussed in [K40]. If Earth's magnetic field is accompanied by dark flux sheets in entire magnetosphere carrying field  $B_{end} = 2B_E/5$ , then the value of  $T(e)$  would become  $T(e) = 5$  seconds for  $B_E = 11.2$  nT.

To sum up:

1. the average magnetic field in plasma sheet corresponds to a definite p-adic length scale;
2. the mysterious time scale of the Comorosan effect pops up as a basic magnetic transition time in magnetic lobes and plasma sheet and is related to bio-control by enhancing catalytic rates: it is however essential that the "dark" counterpart  $B_{end} = 2B_E/5$  of  $B_E$  associated with living matter is in question;
3. plasma sheet is found to be a complex self-organizing system with the velocity distribution of ions representing complex features (such as "eyes" and "wings" !) [F10].

These findings force to seriously consider the possibility that plasma sheet and magneto-pause and perhaps even magnetic lobes might perform high level bio-control utilizing MEs and supra-currents along magnetic flux tubes forming the extension of the endogenous magnetic circulation to the entire magnetosphere.

## 2.2 $Z^0$ Magnetosphere

Classical  $Z^0$  fields are in a key role in TGD based model of living matter and chiral selection in the living matter is one of the anomalous phenomena explained by the presence of classical  $Z^0$  fields. Therefore one expects that also  $Z^0$  magnetosphere of Earth is crucial for the realization of sensory representations and/or of motor control.

### 2.2.1 Clarification of basic notions

The original erratic view was that it is possible to speak about space-time sheets carrying only em or  $Z^0$  fields: hence the term of  $Z^0$  magnetosphere. The notion of induced gauge field combined with field equations however predicts strong constraints between various classical fields and it is not possible to have a situation in which either em -,  $Z^0$  -, or gluon field alone would be present as a classical field. Hence it is quite possible that same space-time sheets define both magnetosphere,  $Z^0$  magnetosphere, and color magnetosphere.

For instance, for vacuum extremals with vanishing induced Kähler form classical em field  $\gamma$  and  $Z^0$  field satisfy

$$\gamma = -\frac{\sin^2(\theta_W)}{2}Z^0 \simeq -\frac{Z^0}{8}$$

for  $\sin^2(\theta_W) = .23$ . Note that classical  $\gamma$  and  $Z^0$  fields are defined by vector potentials defined as  $eA_{em}$  and  $g_Z A_Z$ . For space-time sheets for which  $CP_2$  projection is  $r = \infty$  homologically non-trivial geodesic sphere of  $CP_2$  (see the appendix of the book) one has

$$\gamma = \left(\frac{3}{4} - \frac{\sin^2(\theta_W)}{2}\right)Z^0 \simeq \frac{5}{8}Z^0 .$$

The induced  $W$  fields vanish in this case and they vanish also for all geodesic sphere obtained by  $SU(3)$  rotation. For homologically trivial geodesic sphere a standard representative is obtained by using for the phase angles of standard complex  $CP_2$  coordinates constant values. In this case induced em,  $Z^0$ , and Kähler fields vanish but induced  $W$  fields are non-vanishing. One can say that for non-vacuum extremals with 2-D  $CP_2$  projection color rotations and weak symmetries commute. Note that neutral and  $W$  MEs play a key role in the TGD based model of living systems.

What is true that ordinary particles at space-time sheets behave as if they had vanishing weak charges with respect to long range gauge fields. TGD however predicts an entire hierarchy of scaled up variants of standard model physics for which particles have scaled down mass spectrum. Also dark matter hierarchy is predicted: in this case masses remain invariant in the scaling  $\hbar \rightarrow \lambda\hbar$ , with  $\lambda \simeq 2^{11}$  in the physically most interesting situation, but Compton lengths and time and thus sizes of particle space-time sheets are scaled up since they are proportional to  $\hbar$ . This makes possible macroscopic quantum phases with light particles carrying weak and color charges. Even ordinary nuclei can carry anomalous weak and thus also em charges. It seems that these exotic weak and em charges could be central for the proper understanding of even ordinary condensed matter physics and in living matter this exotic new physics would be of crucial importance.

### 2.2.2 $Z^0$ magnetic field of Earth

Consider first  $Z^0$  magnetic field accompanying the Earth's magnetic field.

1. If non-vacuum extremals with 2-D  $CP_2$  projection are involved the  $Z^0$  field strength satisfies

$$g_Z B_Z = \frac{1}{\frac{3}{4} - \frac{\sin^2(\theta_W)}{2}} eB \simeq \frac{8}{5} \times eB .$$

For  $B =_B E$   $Z^0$  magnetic cyclotron frequency scale would be nearly the same as the magnetic one with alpha band map scaled to  $\sim 16$  Hz so that the cyclotron spectrum of exotically ionized nuclei would be in EEG range.

In this case the question arises, whether em or  $Z^0$  flux quantization fixes the area of flux tubes. For a rational value of  $\sin^2(\theta_W)$  it is possible to satisfy both flux quantization conditions if the integers characterizing the flux quanta satisfy

$$\frac{n_\gamma}{n_Z} = \frac{Z_\gamma}{Z_Z} \times \left(\frac{3}{4} - \frac{\sin^2(\theta_W)}{2}\right) .$$

2. If vacuum extremals with 2-D  $CP_2$  projection or small perturbations of them are in question the  $Z^0$  field strength satisfies

$$g_Z B_Z = -\frac{2}{\sin^2(\theta_W)} \times eB \simeq 8 \times eB ,$$

so that  $Z^0$  magnetic field would dominate and one might think that  $Z^0$  magnetic flux tubes corresponds to almost vacuum extremals. Also in this case both flux quantization conditions can be applied.

An interesting question is whether the  $Z^0$  magnetic field forced by the  $CP_2$  geometry alone should have as its source rotating exotic particles carrying  $Z^0$  charge. Exotically ionized nuclei are a natural candidate in this respect.

Symmetry considerations favor the assumption that the overall topology of  $Z^0$  magnetic field is essentially the same as that of magnetic field. If some fraction of atomic nuclei are  $Z^0$  ions they can create  $Z^0$  magnetic field, and it is plausible that Earth's  $Z^0$  magnetic field receives a large contribution from the rotational motion of these nuclei so that the  $Z^0$ -magnetic axis would most naturally be the same as the rotation axis of Earth and not same as the axis of magnetic field so that different space-time sheets would be in question.  $L(k = 173)$  next to  $L(169)$  associated with the Earth's magnetic field is the first guess for the p-adic length scale characterized  $Z^0$  magnetic field of Earth. If almost vacuum extremals are in question,  $Z^0$  cyclotron frequency scale is by a factor  $2/16\sin^2(\theta_W) \simeq 1/2$  smaller than the magnetic one.

### 2.2.3 Are $Z^0$ magnetic van Allen belts there?

The symmetry between magnetism and  $Z^0$  magnetism would suggest that the  $Z^0$  counterparts of van Allen belts and ring currents are also there and form a controlling part of the  $Z^0$  superconducting dynamo generating Earth's  $Z^0$  magnetic field. Exotically ionize ordinary ions and atoms would contribute to the  $Z^0$  ring currents.  ${}^4He$  ions are abundant in solar wind and exotically ionized  ${}^4He$  nuclei are of special interest. In particular, tetra-neutron [C2, C1] could be interpreted as an exotically ionized  $He_4^{2+}$  nucleus carrying two units of  $Z^0$  and em charge in  $d\bar{u}$  type color bonds between nucleons [K33]. The lifetime of tetra-neutron is about  $10^{-7}$  seconds. A continual ionization of  ${}^4He$  nuclei by dark  $W$  MEs would make possible for tetra-neutrons to serve as a source of dark  $Z^0$  magnetic field. The interaction with biosphere could be responsible for the ionization if ring current flows along space-time sheet serving as a magnetic body controlling biosphere.

Also dark variants of elementary particles carrying weak charges could contribute to the ring current. Note that the protonic radiation belt is believed to result through the decay of highly energetic cosmic ray neutrons to protons. Also Sun should have both magnetic and  $Z^0$  magnetic belts controlling to some extent the solar  $Z^0$  magnetic dynamo. As already noticed, the TGD based model for rotating astrophysical objects automatically predicts dynamolike structures. Planetary orbits could carry the ring currents controlling solar magnetic and  $Z^0$  magnetic fields and thus providing a feedback mechanism. Indeed, in the model of the tritium beta decay anomaly one is forced to assume that also Earth's orbit is surrounded by a dark neutrino belt [K33].

## 2.3 Observations Making Bells Ringing

Below I summarize some findings which turned out to be very useful in the attempts to understand whether and how magnetosphere could be a self-organizing living system possibly performing also bio-control.

### 2.3.1 Magnetospheres as self-organizing systems

The view that magnetospheres are self-organizing systems is supported by the observations accumulated about the magnetic self-organization of the solar system during last decades reviewed in [J1]. According to this report we are living a period of transition basically due to a penetration of highly charged material from the interstellar space into the interplanetary space from an interstellar plasma structure containing various kinds of magnetic structures.

This energy feed is inducing various kinds of processes affecting not only the atmo-, iono-, and magnetospheres of Earth but also solar and other planetary magnetospheres. Also interplanetary transmitting properties are affected. The Schumacher-Levy comet, which for few years ago collided with Jupiter and among other things a induced plasmoid train and had dramatic effects on Jupiter's magnetosphere, is referred to as a "Comet" SL-9 in [J1]. I am not sure whether "Comet" was meant to suggest that SL-9 was actually a plasma magnetic structure from the interstellar space. There is also evidence that we are moving to a similar temperature instability that occurred for 10.000 years ago and which might have initiated the development of the bicameral society in turn leading to the modern society much later.



This process could be also seen as a re-self-organization and evolution of consciousness in solar length scale as a reaction to the encounter of heliospheric and interstellar magnetic intelligences. The penetration of interstellar plasmoid like structures to the interplanetary space through the solar magneto-pause could be interpreted as a failure of the magneto-immune system of the heliomagnetosphere. The interaction of the planetary magnetospheres with these intelligent (benevolent?) plasmoid like structures would in turn induce the re-self-organization. Needless to say, the interaction of the two intelligences might have far-reaching consequences for the evolution of the ordinary life.

### 2.3.2 Connection with the Comorosan effect

Comorosan effect means that the irradiation of living manner by visible light over a period which is a multiple of  $\tau_C = 5$  seconds implies enhanced catalytic activity [I8, I3]. According to private communication, this effect is not restricted to living or even organic matter. TGD explains the effect [K40] but the deeper explanation of the time scale of  $\tau_C = 5$  seconds has remained a longstanding challenge.

The 5 second time scale associated with Comorosan effect is the spin flip time scale associated with proton's  $\Delta n = 1$  cyclotron transition in the field of  $B_{end} = 13.32$  nT (which could correspond to the value of  $B_E = 5B_{end}/2 = 33.3$  nT in magnetic lobes).  $\tau_C$  is also associated with proton's  $\Delta n = 3$  cyclotron transition and the electronic cyclotron spin flip in the field of  $B_{end} = 2/5B_E = 11.2$  nT (plasma sheet).

Lungs contain magnetic particles giving rise to  $\sim 10$  nT magnetic field and thus for  $B_{end} = 2B_E/5$  to  $n = 3$  protonic cyclotron transitions and electronic cyclotron spin flips in 5.5 second scale, which is very near to  $\tau_C$ . Perhaps Comorosan effect is used by the outer magnetosphere to affect the behavior of living matter and lungs are involved with this process.

### 2.3.3 Plasma sheet as a “microchip”

Plasma sheet should be a seat for magnetospheric sensory representations in theta and delta bands and among other things provide a model of magnetospheric self. If plasma sheet has this kind of role, it should manifest itself in its properties. Plasma sheet should be self-organizing, complex structure rather than system near thermal equilibrium. Plasma sheet is also expected to perform bio-control.

There is a fascinating finding about the “memory chip” character of the organization of the ionic velocity distribution in the plasma sheet [F10]. The belief was that the distribution is a Maxwellian thermal distribution but a complex organization of the number of ions as a function of speed and direction relative to the direction of the local magnetic field has been detected [F10]. By coloring the bins representing small volumes of the velocity space, one finds that 3-dimensional features like “eyes” and “wings” appear! The proposed interpretation is that these features codes the history of ionic currents. One cannot exclude the possibility that these ionic currents could reflect even our sensory experiences. The prediction is that also other transition regions (in particular magneto-pause) should exhibit similar complex self-organization patterns. The simplest possibility is that the velocity patterns of ordinary electrons reflect the underlying pattern of dark matter at the dark magnetic flux tubes forming perhaps some kind of sensory representations.

## 3 General Assumptions About Sensory And Motor Representations

If one believes that magnetosphere is a living organism, the first thing one can do to concretize this belief, is an attempt to generalize the general wisdom about living organisms in the biosphere to the new context. Thus the notions of metabolism, sensory representations, and motor control should have magnetospheric counterparts. This might provide also new views about the physics of magnetosphere. The physics of magnetosphere could also allow to develop new ideas about TGD inspired quantum biology. The fact that also endogenous magnetic fields are of crucial importance for the understanding of ordinary life in TGD framework, means that the basic distinctions might be due to difference between scales.

### 3.1 Magnetosphere As A Living Organism

Consider now the analogy between biological organisms and magnetosphere in more detail.

1. In the living matter magnetic flux tubes and corresponding supra currents define what might be called magnetic circulation, kind of analog of the blood circulation, along which information and energy is carried by the supra currents. At the quantum level the spatial variation of the phase of the complex order parameter is a correlate for the supra current and the net phase changes around closed loops (say loop around leg) coming as multiples of  $2\pi$  characterize these currents. One of the earliest TGD inspired ideas about bio-systems was that these almost topological quantum numbers are ideal for the representation of biologically relevant information. Phenomena supporting strongly the existence of this kind of topological quantum numbers are known [A1].

Also in the case of magnetosphere similar magnetic circulation should be present and the phase increments around closed loops should represent “magnetobiological” information. For instance, supra currents could circulate around the plasma sheet and magneto-pause. Since plasma sheet is a self-organizing structure with very complex fractal structure, huge amounts of magnetobiological information could be stored to these supra currents.

2. Magneto-pause would be kind of a magnetic skin insulating the magnetic organism from the interplanetary magnetic field supra currents. Perhaps a similar insulation occurs also in the skin of the biological organisms and prevents the penetration of harmful magnetic fields to the organism. This would mean the flow of supra currents along skin. Typically the current would rotate around, say, leg and there is indeed evidence for the selection rules implied by the topological quantum numbers associated with these kind of supra currents [A1]. The recombination of the flux tubes of solar magnetic field with those of Earth at the magneto-pause could give rise to a “sensory input” from the magnetic skin: certainly solar supra currents carry a lot of negentropy. Polar cusps and caps would play the role of the parts of body which feed in the metabolic input and feed out the metabolic waste.
3. Magnetic Mother Gaia has besides magnetic skin also a material skin, biosphere. Individual organisms would act as sensory receptors. The notion of magnetospheric tactile senses mapping entire biosphere to the magnetosphere seems very natural in the conceptual framework of TGD inspired theory of consciousness.

### 3.2 Magnetospheric Nervous System

One could also try to find whether the magnetospheric counterpart of the nervous system might make sense. Of course, one must be very cautious in making this kind of associations. The first thing to notice is that nervous system corresponds to the self-organizing and strongly dissipating parts of organism. In magnetosphere the plasma rich regions certainly satisfy this criterion. The most one can hope is that there is direct mapping between brain structures and magnetosphere such that dominating EEG MEs in brain area project to the corresponding regions of the magnetosphere and define magnetospheric sensory representations there.

1. One function of the nervous system is to build a sensory map of the material world. Thus also the magnetospheric nervous system should process “sensory” information about biosphere. This fixes naturally the order of the hierarchical structure: the larger the distance from Earth’s center, the higher the hierarchy level. This also conforms with the fact that lower frequencies must correspond to the higher levels of self hierarchy.
2. The interpretation for the magnetosphere would be as brains of Mother Gaia receiving sensory input from biosphere with various organisms serving as sensory receptors. Outer magnetosphere would correspond to the highest and most abstract level of information processing contributing also to the brain consciousness via the sharing of mental images. Corresponding magnetic time scales indeed correspond to brain time scales. Self-organization is maximal inside magneto-pause and plasma sheets. Perhaps the identification as the counterpart of the cortex for either or both of these structures is appropriate. Magnetic lobes, analogous to the brain cavities, certainly serve as stores of magnetic energy. The low density of ions and

approximate spatial constancy of the magnetic field means that magnetic lobes are not tailor made for the sensory representations. Day and night sides of the magnetosphere are good candidates for the magnetospheric counterparts of posterior (hind brain) and anterior (frontal lobes) parts of the cortex. It will be found that resonant magnetospheric sensory representations come in two basic types depending on whether the projector MEs from brain project to the same or the opposite side of the globe: the asymmetries between these representations resemble the asymmetries between left and right brain.

3. One can continue with the structural analogies. The inner magnetosphere could correspond to the subcortical regions. The scales for the magnetic transition frequencies suggest that protonic inner belts would perhaps be the counterparts of thalamus and hippocampus: representation of our long term memories could be in question. Electronic inner belt might correspond to cerebellum characterized by higher EEG frequencies. The outer electronic belt could correspond to basal ganglia and limbic brains (note the toruslike topology) and be involved with our imagination and planning of motor actions and also with speech production. Ionosphere, where also the representations based on heavier ions are possible, would correspond to brain stem, spinal chord, and the neuronal level. p-Adic length scale hypothesis and  $v = Lf$  scaling law [K25] give a rather precise meaning for this correspondence.

Individual organisms could be seen as sensory receptors of Mother Gaia and would be accompanied by their personal sensory magnetic canvases for which magnetic field strengths could be much weaker, and perhaps directed along the direction of the local magnetic field and penetrating to the interplanetary space. The simplest assumption is that the projector MEs to the personal magnetic canvas intersect the flux tubes of Earth's magnetic field and in this manner generate magnetospheric sensory representations which might serve as memory representations.

The analogy with nervous system suggests that there is two-directional information transfer between magnetosphere and ordinary living organisms. Magnetospheric sensory representations and magnetospheric "motor control" would correspond to this bi-directional information transfer.

### 3.3 Magnetospheric Metabolism

Living systems are self-organizing systems in which highly negentropic energy flow enters the system, delivers its negentropy, and leaves the system. Usually only the negentropy of the solar radiation is considered as important. If magnetosphere is a living organism, also the negentropy feed by the ionic supra-currents flowing along the magnetic flux tubes of the solar magnetic field should play a key role.

Plants get their ordered energy directly from solar radiation via photosynthesis. Magnetosphere would in turn receive its energy and negentropy by breathing solar wind. The flow of ordered energy would enter via the polar cusps and magneto-pause via the leakage of the magnetic flux tubes of solar magnetic field to the magnetic lobes followed by a recombination with the flux tubes of Earth's magnetic field. Magnetic lobes might be seen as reservoirs of magnetic energy and information resulting from the "sensory" input from solar wind and from Earth.

Magnetic storms transfer this energy along the plasma sheet down to radiation belts during magnetic storms and sub-storms. The incoming ionic flux should flow out back to the interplanetary space somewhere. A good guess is that inertia forces the leakage of the supra current to a larger space-time sheet at the highly curved tips of the outer radiation belts dipped towards the polar caps, and the ions leak out to the interplanetary space along larger space-time sheet as Ohmic currents. The radiation observed instrumentally at the polar caps could result in this process. The energy vacuum zero point energy liberated in the process is about  $E_0 = \pi^2/md^2$ , where  $d$  is the thickness of the magnetic flux tube determined by the flux quantization. This corresponds to energy of about  $2 \times 10^{-9}$  eV which is very small as compared to the energy of the ion.

The energy feed is utilized to pay the energy bills of the dissipative ionic flow along the plasma sheet towards radiation belts and of the dissipative ring currents participating to the control of Earth's magnetic field by super-conducting dynamo mechanism. Also the ionic current flowing along circular flux tubes of the magneto-pause needed to build the magnetic field inside magneto-tail uses the energy of the solar wind. These circulating currents could be supra currents flowing along magnetic flux tubes which correspond to some other, presumably longer p-adic length scale so that the magnetic field would be weaker.

### 3.4 General Ideas About Sensory Representations

Consider first what the minimal assumptions relating to the sensory representations might be.

#### 3.4.1 Two basic types of representations

The crucial assumption is that neither ionosphere nor Earth's surface can serve as a Faraday cage for the MEs nor for the magnetic flux tubes possibly involved. This is as it should be if the notion of many-sheeted space-time concept makes sense. If this assumption fails, a person in Faraday cage would lose most of the contents of consciousness. This prediction is testable and there are claims that the ELF radiation in alpha band can penetrate Faraday cage (the work of Dr. Andre Puharich): unfortunately, it is not clear to me whether these stories are only modern city folklore or not.

##### 1. Personal representations

The magnetic body consisting of vertical magnetic flux tubes associated with brain and body could serve as a personal magnetic sensory and motor canvas. Since the flux tubes of Earth's magnetic field emerge from the surface of Earth almost vertically, vertical flux tube structures could emerge as structures locally parallel to local Earth's magnetic field from the brain and body. These structures cannot however coincide with the field structures or Earth and flux tubes carrying magnetic field much weaker than Earth's magnetic field could be involved. For instance, eye contains static field of about 10 pT and the magnetic particles of lungs give rise to magnetic fields of order 10 nT. Also brain contains magnetic particles and they presumably give rise to net static magnetic field besides taking care that sensory projectors are oriented parallel to magnetic field and thus define a fixed coordinate frame for the sensory representations.

Ordinary magnetic fields with these typical intensities could be accompanied by dark magnetic fields satisfying  $B_{end} = 2B/5$  and corresponding to  $n = 5$  length of dark matter having flux tube radii scaled up by factor  $n = 5$  and perhaps making possible topological quantum computation in some sense [K2].

The transversal surface area (thickness) of the magnetic flux tube would code for the distance of the perceptive field or, more generally, some geometric property of a feature. The magnetic structures associated with pyramidal cells and red blood cells could anchor the coordinate frame for the sensory representations to the coordinate frame defined by the directions of Earth's magnetic and gravitational fields. Somehow the orientation of the ME projectors must be anchored to this frame and vertical flux tube structures might allow to achieve this anchoring. The cellular magnetic dipoles should be parallel to the local Earth's magnetic field which suggests that vertical magnetic fields might have different origin.

##### 2. Magnetospheric representations

Is the notion of personal magnetic sensory canvas necessary? One could consider also the possibility that everything is represented on the flux tubes structures of Earth's magnetic (and  $Z^0$  magnetic) field.

1. If only the magnetic flux tube structures are used so that sensory representations mean sharing of the brainy mental image with the mental image of Mother Gaia about position, one ends up with problems relating to space traveller consciousness. For instance, the nearby magnetic field around the moon traveller should differ dramatically from that at the surface of Earth so that contents of consciousness should change dramatically. This is not the case. Thus it seems that personal sensory magnetic canvas is there and codes at least for the sensory experience. Magnetic Mother Gaia could however contribute to various third person aspects of consciousness and also to memory.
2. TGD based explanation of near death experiences supports the notion of magnetic body remaining after the "physical death" and this body could correspond to the vertical magnetic flux tube structure or part of the magnetospheric sensory canvas.
3. Vertical magnetic flux tubes would also make possible a direct interaction between brain and Earth's magnetic field. Sharing and fusion of our mental images and the mental images of

Mother Gaia becomes possible. In particular, supra currents could flow between magnetic sensory canvas of Mother Gaia and brain and allow the control of organisms.

Thus it would seem that it is best to be as general as possible. Personal magnetic canvases should be there but also Mother Gaia is interested about what happens in our brain and contributes to our consciousness by the sharing of mental images.

### 3.4.2 Place coding

Place coding is one of the key ideas of TGD based theory of sensory and motor representations. Place coding relies on the observation that the local strength of the magnetic field determines which em frequency induces magnetic transitions of the super-conducting particles residing at a given distance along the magnetic flux tube having a varying thickness. Therefore it becomes possible to code geometric information to frequency and translate it to a distance along the magnetic flux tube. Thus the requirement that endogenous frequency equals to the magnetic transition frequency determines a two-dimensional surface of the magnetosphere and in the case of personal sensory canvas point of the magnetic flux tube.

Endogenous cyclotron frequency  $f_c$  corresponds to ME with length which is multiple of the minimal length  $L = c/f_c$ ,  $f_c = qB/2\pi m$ , where  $q$  and  $m$  are the charge and mass of the charge carrier. If this length equals to the distance from brain to the point of the sensory canvas, ME acts as a waveguide amplifying the signal. This condition is very stringent and in the case of magnetosphere allows only one-dimensional curves as its solution. In the case of the personal sensory canvas  $S \propto L$  condition for the transversal area  $S$  of the magnetic flux tube as function of its length  $L$  guarantees resonance condition. In the case of magnetic mirrors, a further amplification results from the TGD counterparts of Alfvén waves representing oscillations of the magnetic flux tube and satisfying the dispersion relation  $f_n = nc/2L$ .

One must however notice the possibility that ME (and corresponding parallel magnetic flux tube in the case of a magnetic mirror) only intersects Earth's magnetic flux tube rather than ending to it. In the case of ULF frequencies associated as magnetic transition frequencies with the magnetic lobes carrying very weak magnetic fields one must indeed assume that MEs can be much longer than the distance from Earth to the activated point of the sensory canvas. Meteor sounds provide support for the existence for MEs having length  $\lambda = c/f$ ,  $f \sim 40$  Hz.

#### 1. Place coding for features inside brain

The presence of endogenous magnetic fields giving rise to a magnetic circulation analogous to blood circulation is assumed. The strength of the endogenous magnetic field must be near to that of Earth's magnetic field. Endogenous place coding of the features by magnetic flux tube thickness is assumed and there is evidence for this [J10]. The genetically coded magnetic crystals inside pyramidal neurons and haemoglobin molecules could serve as sources of magnetic fields. If endogenous magnetic fields result from the self-organization of Earth's magnetic field, one can understand why the flux quanta of the complex endogenous magnetic fields have approximately the same thickness as those of Earth's magnetic field.

#### 2. Place coding at the personal magnetic sensory canvas

The simplest hypothesis is that personal magnetic canvas consists of a magnetic flux tube bundle defining an almost vertical cone and that each straight flux tube is accompanied by a parallel ME. This structure will be referred to as magnetic mirror with the understanding that the ends of ME intersecting the magnetic flux tube define the mirrors. A ME of length  $L$  acts naturally as a wave guide amplifying frequencies, which come as harmonics of the fundamental frequency  $f = c/L$  (whether also  $f = c/2L$  might be considered: this depends on the boundary conditions).

ME could intersect the flux tube at any point of the tube. Alfvén waves [F17] correspond in TGD framework to oscillations of magnetic flux tubes and have spectrum  $f_n = nc/2L$  for fluxtube length  $L$ . More general types of Alfvén waves result if the magnetic flux tube has some kind of discontinuity or sharp gradient in which Alfvén waves are reflected. The intersection of ME with flux tube (this is the optimal situation) or a highly curved portion of the magnetic flux tube could serve as this kind of discontinuity. Alfvén waves or reflected Alfvén waves can resonantly amplify the wave propagating inside ME.

Since magnetic flux is quantized, the average intensity of the magnetic field inside the flux tube is proportional to its transverse area  $S$ . Place coding by magnetic transition frequencies is achieved if the transverse area  $S$  of the flux tube is proportional to the distance  $L$  along the tube:  $S \propto L$ . This law can obviously hold true only above some threshold distance  $L_{min}$ . An explicit form of the resonance condition reads as

$$\begin{aligned} f &= \frac{c}{L} = f_m = \frac{keB}{m} = f_m^{max} \frac{S_{min}}{S} , \\ f_m^{max} &= \frac{keB_{max}}{m} . \end{aligned} \quad (3.1)$$

Here  $k$  is a numerical constant characterizing the particular magnetic transition frequency and  $f_m^{max}$  is the maximum value of the endogenous frequency and  $S_{min}$  corresponding flux tube thickness. This implies

$$L = \frac{c}{f_m^{max}} \frac{S}{S_e} = \frac{m}{keB_{max}} \frac{S}{S_{min}} . \quad (3.2)$$

For  $L > L_{min}$  the surface of the flux tube is paraboloid. Note that there is separate flux tube for each kind of magnetic transition frequency, in particular for each ion. Harmonics of a given cyclotron frequency can be however coded by the harmonics of the fundamental frequency ME.

Certain findings about the imprinting of water frequencies [I1] can be understood if the endogenous magnetic flux tubes satisfy the  $L \propto S$  law [K12]. Among other things this law also implies that the energy density of the magnetic field per unit length is constant: this is very natural in equilibrium situation.

MEs need not be straight cylinder like structures: the general solution ansatz allows also curved MEs but it is not clear whether any curved magnetic flux tube could form a magnetic mirror with a parallel ME. The magnetic flux tubes associated with the personal magnetic canvas need not be (only) those of Earth's magnetic field and the entire p-adic length scale hierarchy might be involved. For instance, the static magnetic field associated with eye is about 10 pT and corresponds to electronic cyclotron period about 8.87 seconds. If head is accompanied by a magnetic flux tube of thickness of order 8 cm, flux quantization implies that the corresponding electronic cyclotron time is of order 30 minutes.

### 3. Place coding for magnetospheric representations

In the case of magnetospheric representations analogous place coding can be assumed for the distances of the objects of the perceptive field and translates the distance to a cyclotron frequency scale defined by Earth's magnetic field. The thickness for the magnetic flux tube of Earth's magnetic field, varying as  $(r/R)^{3/2}$  in dipole approximation, provides the place coding for the distance of an object of perceptive field. EEG ME with ionic cyclotron frequency generates cyclotron transition at the magnetic flux tube of Earth and is assumed to create sensory self representing experienced position ("feeling of existence") entangled with various sub-selves of brain representing "features". This can be also interpreted as a sharing and fusion of mental images: one of them possessed by the "magnetic Mother Gaia" and the second one by the organism.

In the simplest model EEG MEs generate magnetic transitions at magnetic flux tubes amplified to quantum phase transitions at and in this manner give rise to the sensory and other representations.

### 4. How projector EEG MEs are generated?

EEG MEs are generated by the dropping of ions from the atomic (or some larger) space-time sheets to the magnetic flux tubes of endogenous magnetic fields having roughly the same strength as Earth's magnetic field. The dropping ion enters into a cyclotron state with a high value of magnetic quantum number  $n$ , and this state decays by emitting ELF radiation at multiples of the cyclotron frequency. These ELF photons or ELF em fields in turn can induce magnetic transitions at the magnetic flux tubes of the appropriate magnetic structure.

In many-sheeted space-time particles topologically condense at all space-time sheets having projection to given region of space-time so that this option makes sense only near the boundaries

of space-time sheet of a given system. Also p-adic phase transition increasing the size of the space-time sheet could take place and the liberated energy would correspond to the reduction of zero point kinetic energy. Particles could be transferred from a portion of magnetic flux tube portion to another one with different value of magnetic field and possibly also of Planck constant  $\hbar_{eff}$  so that cyclotron energy would be liberated.

This mechanism or some of its alternatives need not be realized only at the level of brain. Also the plasma rich transition regions of the magnetosphere having interpretation as magnetospheric counterparts of brain structures could communicate with other similar regions by the same mechanism. What is needed is that the plasma ions return to high  $n$  cyclotron state at the magnetic flux tube, which then decays by emitting cyclotron radiation having MEs are topological correlate. Magneto-pause, plasma sheet, the transition region between inner and outer magnetospheres, and radiation belts are especially natural candidates for regions communicating in this manner.

**3.4.3 Hierarchy and modularity of representations**

An entire hierarchy of sensory representations is predicted. Scaling law states that there is a mapping of brainy p-adic length scales  $L$  to much longer p-adic length scales  $L_{EEG} = \lambda_{EEG} = (c/v) \times L$ , where  $v$  is the typical conduction velocity for nerve pulses [K25]. The interpretation is that there is a physical mechanism transforming of EEG frequencies to much higher endogenous frequencies

$$f_h = c/L = (c/v)f_{EEG} \quad , \quad (3.3)$$

and vice versa [K13].

Quantum entanglement between different levels of the hierarchy makes possible modularity. The features assigned by quantum entanglement to a given point of the sensory canvas at given level can be representations realized at some lower level canvas. For instance, simple geometric features like triangles and circles could be represented at lower level canvas and associated with a point of higher level sensory canvas by quantum entanglement.

Similar hierarchical structure and modularity is expected to hold true for the representations at the magnetospheric sensory canvas. This applies also to the motor representations. This means modulation hierarchy. The lower level in the hierarchy adds kind of a ripple to the long wave length representation at the higher level. This applies also in the temporal domain. Thus rough control commands from higher level are gradually detailed at the lower levels (motor action as carving of 4-dimensional statue by adding gradually increasingly finer details).

**3.4.4 Also  $Z^0$  magnetospheric representations could be there**

$Z^0$  magnetic fields are crucial in the model of hearing and the memetic code believed to be behind the spoken language [K24]. Cognitive neutrinos pairs could provide one realization of the memetic code [K24]. Most importantly, classical  $Z^0$  force could be strong in the biologically most relevant length scales. Indeed, the p-adically scaled up electronic Compton scales corresponding to  $k = 151, 157, 163, 167$  are in the range 10-2500 nm. These primes correspond to Gaussian Mersennes  $(1 + i)^k - 1$  and are excellent candidates for defining p-adic lengths scales associated with scaled down fractal copies of standard model physics. The reason is that the known smaller Mersennes and Gaussian Mersennes correspond to physically important length scales in the hitherto studied energy range (below TeV energies).

The work of Shnoll [E3], [E3] demonstrates a correlation between fluctuations of radioactive and biological rates and astrophysical periods. This encourages to think that quantum communications *resp.* control based on  $Z^0$  *resp.*  $W$  MEs could be present also at the level of solar system and even longer length scales. The interpretation would be in terms of dark variants of weak bosons having very low masses.

**3.5 What Brain Structure And Fractality Teaches About Magnetospheric Motor Control?**

The first bundle of questions relates to the idea that brain structure and fractality could teach something about magnetospheric motor control (and perhaps also vice versa!).

**3.5.1 Can one identify magnetospheric motor and sensory areas?**

The mapping of the brain structure to that of magnetosphere to be discussed later in detail leads to the conclusion that day side outer magnetosphere very naturally corresponds to hind brain containing associated sensory areas whereas night side outer magnetosphere would correspond to frontal brain containing associative motor areas and association regions for high level planning. For the inner magnetosphere the only sensible option is that the representations at the same side of the globe correspond to sensory areas (otherwise one cannot realize 40 Hz sensory representations): those at the opposite side of the globe could, but need, not to correspond to motor areas. Right and left brain hemisphere in turn correspond to northern and southern magneto-hemispheres.

The example of brain suggests that the lowest motor and sensory areas are relatively hard wired. The higher areas responsible for the imagination and planning of the motor action should be less hard wired. Thus the areas responsible for planning imagination should be initial value sensitive and near to criticality. This would suggest that in the case of magnetosphere transition regions are the regions which are most natural candidates for sensory and motor areas. Bow shock, magneto-pause, plasma sheet, the transition region between inner and outer magnetosphere, and inner and outer radiation belts are good candidates for this kind of regions. Inner and outer radiation belts and the transition region between inner and outer magnetosphere could correspond to primary, secondary and tertiary sensory and motor areas whereas magneto-pause would correspond to sensory and motor associative regions. Even bow shock might be involved.

The magnetosphere of Earth is part of the solar magnetosphere and if helio-magnetosphere controls the behavior of the planetary magnetospheres, it must use those parts of the planetary magnetospheres which it can affect. Note that the effect of the solar spot activity on the human sensory consciousness (complex hallucinations) could be understood as being partially due to the effect of the solar wind on the day side magneto-pause, which is the counterpart of the sensory associative areas.

**3.5.2 How do the magnetospheric structures communicate?**

Ionic supra currents are the most obvious means of communication and would be counterpart for the corresponding communications at the level of brain a la TGD. Also Ohmic ionic currents in plasma rich regions (the current along plasma sheet down to ionosphere, ring currents, ...).

The topology of Earth's magnetic field provides a good overall view about the "neural circuitry" of Mother Gaia. There are ionic supra currents flowing along magnetic flux tubes around magnetosphere, both inner and outer. In the case of magnetic lobe, which seems to extend to the distance  $10^3 R$  these currents are also present. Radiation belts contain besides ring currents also ionic supra currents running back and forth along magnetic flux tubes. Josephson junctions between magnetic flux tubes might be an overall important aspect of the communications.

There are also currents associated with the transition regions where the tangential component of the magnetic field changes (magneto-pause, transition region between inner and outer magnetosphere, the boundary of the plasma sheet, ...) running along the transition surface and orthogonal to the discontinuity of the magnetic field. These currents might be also supra currents and make possible horizontal communications inside these structures (magneto-pause would be the counterpart of associative regions) analogous to the horizontal neural communications inside regions of brain.

The regions of magnetosphere could communicate also by ME projectors. Also resonance is possible. For instance, the day side magneto-pause (associative sensory regions) and night side magneto-pause (associative motor regions) could communicate by projector MEs associated with the protonic cyclotron transitions and electronic spin flip transition.

**3.5.3 What is the counterpart of the thalamocortical circuitry?**

One can also make questions about the counterpart of the thalamocortical resonance circuitry.

1. Inner and outer radiation belts turn out to be the magnetospheric counterparts of the primary and secondary sensory (same side of the globe) and motor (opposite side of the globe) areas in the mapping of the brain structures to magnetospheric structures. If the magnetic flux tubes of Earth emanate also from brains as they should do, a direct interaction with brain



with the mediation of the supra currents becomes possible. Second form of control is based on ME projectors, in particular  $Z^0$  MEs.

2. Radiation belts do not only serve as radiation shield but would control the super-conducting dynamo generating magnetosphere. Since radiation belts are strongly affected by cosmic rays and solar wind, they indeed serve as kind of motor organ in very general sense. During solar storms the ionic supra currents running back and forth in radiation belts can leak from the magnetic bottle and end up to the the super-conducting dynamo in Earth interior and thus modify the strength of magnetic field. This control would be the magnetospheric counterpart of long term control of brain upon itself changing the very structure of brain.
3. Earth's inner core takes the role of thalamus in the mapping between brain and magnetospheric structures. This would suggest that Earth's inner core serves as a relay station through which the ionic supra currents run between regions of magnetospheric brain. Thalamocortical feedback suggests a strong feedback from radiation belts to magnetospheric thalamus and the dipole structure of the magnetic field guarantees this. This would however require that the super conducting ions can leak from the magnetic bottle formed by the increasing strength of the magnetic field inside magnetic tube toward northern and southern latitudes. Classically this is achieved if the longitudinal kinetic energy of the charged particle is high enough so that it is not completely transformed to the energy of the transversal motion before entering into the core. It is known that the ions can have much higher energies than expected [F5].

### **3.6 Do The Structures Of Nervous System And MagnetosphereCorrespond To Each Other Fractally?**

Control levels corresponding to magnetic and  $Z^0$  magnetic transition frequencies varying up to the time scale of life cycle might be present and correspond to a hierarchy of motor canvases. If this is the case, the hierarchy would continue to the length scale of light life.  $Z^0$  magnetic structures more or less resembling magnetic ones could be responsible for the hierarchy of motor canvases whereas magnetic structures could represent sensory canvases. The resonance condition  $f = c/L$  fixes the representational hierarchy practically completely by telling the distance at which given frequency is representable resonantly.

The correspondence between sensory areas and the periods of the periodic table follows from the p-adic length scale hypothesis and  $v = Lf$  scaling law [K13]. The model for the magnetospheric sensory canvas gives hopes of understanding this hierarchy at a deeper level, and leads to a general vision about how sensory experience, memory, and imagination correlate with the structure of the magnetosphere.

It must be emphasized that sensory representations of magnetic Mother Gaia are in question: these representations might however be behind our memories and imagination. These representations could result as a by-product of the representations at personal sensory canvas and magnetosphere. The best one can hope that there is a detailed correspondence between brain structures and those of magnetosphere induced by the projector MEs associated with the personal sensory canvas.

#### **3.6.1 Representations in the ionosphere**

For the representations in the lower ionosphere the transition frequencies would not differ appreciably from those at the surface of Earth and the representing ion could be same as the endogenous ion. 10 per cent variation for the endogenous transition frequency would mean variation of 3.3 per cent for distance so that the representations using same ions would make sense up from  $1.01R$  to  $1.04R$  which means the height interval 80-190 km (note that the lower boundary of ionosphere is at about 80 km). Endogenous magnetic field should be at least about 1 percent lower than the external magnetic field to guarantee that representation is above 80 km. Distance condition cannot be satisfied for these representations if one assumes that MEs have length equal to the distance from the representation point.

These representations would correspond to the lowest level representations associated with neurons, spine, and brain stem, which have emerged first during the evolution and should emerge

first also during the development of individual. Also features could be represented using these low level sensory canvases and entangled to the points of the higher level sensory canvases.

At higher heights the representations with  $A_I < A$  are in principle possible and could form a hierarchy. At  $r = 2R$  representing the upper boundary of ionosphere protonic cyclotron frequency is 37.5 Hz.  ${}^4\text{He}^+$  ion would have cyclotron frequency about 12 Hz at this height. Rather remarkably, thalamocortical resonance frequency corresponds to the protonic radiation belt where the density of ions is high and representation should be intense.

### 3.6.2 Inner magnetosphere does not allow representations in theta and delta bands

The resonance condition  $f = c/L$  stating that ME acts as a resonant wave, when applied at the boundaries of the inner magnetosphere ( $4R$  at day side and  $6R$  at night side), implies the lower bound 12.5 Hz *resp* 8.1 Hz for the frequencies representable at day side *resp.* night side. The conclusion is that in day side only beta and gamma bands are representable whereas night side allows also alpha band. This representation independent prediction is of utmost importance since at least our sensory and cognitive consciousness involves mostly beta and gamma bands and during sleep and meditative states theta and delta bands dominate.

One could also wonder whether the first person aspect of consciousness corresponds to the inner magnetosphere rotating with Earth and whether transpersonal consciousness (me experienced from third person perspective as in OBE experiences) could correspond to the outer magnetosphere (which does not rotate with Earth) plus plasma sheet. The frequencies near Schumann frequency would be at the boundary of these two modes of consciousness. During hypnagogy which is between these two modes, Schumann frequency indeed dominates EEG.

Protonic cyclotron transitions represent resonantly in the range 12.5 – 100 Hz (note that the upper bound corresponds to the highest EEG frequencies) and maximum protonic flux in the protonic radiation belt corresponds to frequencies around 40 Hz thalamocortical resonance band. The representation at the same side of the globe would be responsible for immediate sensory memories and the representation at the opposite side of the globe for symbolic, more long term memories. Also electronic spin flip represents: the maximum of the electron density in the outer radiation belt corresponds roughly to 12.5 Hz frequency. The deviation of the magnetic field from the exact dipole form modifies this prediction somewhat. Electronic  $Z^0$  spin flip frequency varies in the range 9.4 – 25.0 Hz and could represent symbolically motor skills (opposite side of the globe and alpha band) and motor imagination occurring in a shorter time scale (the same side of the globe and beta band).

### 3.6.3 Plasma sheet and magneto-pause and consciousness in theta and delta bands

Because of their highly unstable character, both plasma sheet and magneto-pause accompanied by plasma mantle might be seats of the magnetospheric imagination and very high level bio-control realized using protons and electrons. Plasma sheet might also receive sensory input from the magneto-pause.

Ionic density is a direct measure for the intensity of the contribution to the conscious experience coming from given region of space and this is a natural criterion when one tries to understand the possible roles of various magnetospheric structures for consciousness. Plasma sheet [F7] indeed contains a high density of ions and thus could act as a layer of effectively two-dimensional computer screens of thickness of order  $R$ . In this region the intensity of magnetic field transforms from 10 nT to about 20 nT inside lobe immediately above plasma sheet. According to some sources the value of the magnetic field is 30 nT inside the lobe: this might hold true in nearby region. The structure suggests a sensory or a motor representation in which the vertical distance from the sheet represents the distance for the object of perceptive field.

The resonance condition  $f = c/L$  (higher harmonics of fundamental frequency for ME are not allowed) implies that only frequencies from 8.1 Hz down to 0.8 Hz, that is theta and delta band, can be represented in plasma sheet whereas alpha, beta and gamma bands would be represented in the inner magnetosphere at the night side. At the day side only beta and gamma bands are representable. The higher harmonics of protonic cyclotron frequencies make it possible to satisfy this condition in the plasma sheet (the distance of the representing surface varies as  $r/R \propto 1/n$ ). Various cyclotron harmonics would be nicely ordered along the plasma sheet. Similar conclusion

holds true in the case of magneto-pause. Also electronic cyclotron spin flip frequency provides single representation.

The harmonics of the electronic  $Z^0$  cyclotron frequency provide representations in this region. The time scale is very slow: roughly  $Z^0$  representation could be responsible for high level motor control, perhaps for learned motor skills.

The electronic cyclotron spin flip frequency would be of order 1 cycle per 5 seconds whereas protonic cyclotron frequency would be 1 cycle per 15 seconds. 5 second time scale is involved with Comorosan effect. Furthermore, a 5 second delay that has been observed between the onset of a 1 to 2 mT magnetic field (about 40 times stronger than Earth's magnetic field) and the first bursts of brain activity responding to the magnetic field (Science 260 (11 June 1993), 1590). A further fascinating observation to be discussed later is that plasma sheet is a highly self-organizing structure containing "features" like "eyes" and "wings" [F10].

For 10 nT magnetic field the cyclotron time scale is 16.7 seconds for protonic cyclotron transitions and 8.9 ms (112 Hz) for electronic cyclotron transitions. For the latter time scale resonant amplification is not possible. For  $Z^0$  magnetic lobes cyclotron time scales are scaled up by a factor 800 to 3.7 hours and 7.1 seconds for proton and electron respectively. For electron higher harmonics allow to satisfy the resonance condition.

For endogenous  $Z^0$  magnetic field the transition frequencies are around 10 Hz for all atoms and molecules except hydrogen atom and much higher than  $Z^0$  cyclotron frequencies in the magneto-pause and plasma sheet.  $Z^0$  motor control from the magneto-pause is possible if  $Z^0$  MEs generate endogenous sound waves by  $Z^0$  piezoelectric effect, which in turn are transformed to electromagnetic oscillations via the ordinary piezoelectric effect.

In light of these arguments, the idea that plasma sheet and magneto-pause could contribute to our consciousness via the sharing of mental images might make sense. More detailed developments inspire a very concrete mapping between brain structures and magnetospheric structures and plasma sheet corresponds in this mapping to the magnetospheric self model located in insula whereas day side and night side magneto-pauses correspond to sensory and motor association regions. By the sharing of mental images also our self models are represented at plasma sheet.

#### **3.6.4 Are magnetic lobes, magnetosheath, and solar magnetosphere involved?**

The density in magnetic lobes is about .01 ions per cubic centimeter so that these regions are analogous to the brain cavities containing white matter. Thus one might think they do not give a significant contribution to our everyday consciousness. In TGD framework however also blood cells are excellent candidates for defining sensory representations and this contribution to consciousness would correspond to the bodily "what it feels" consciousness (proprioception) whereas neuronal consciousness would represent the world as experienced from outside (seen and heard). Magnetic lobes and more generally, all regions of the magnetosphere outside the transition regions, are good candidates for this kind of sensory and motor representations.

According to [F12] the asymptotic value of magnetic field (outside plasma sheet,  $r \geq 100R$ ) in lobes is 9.2 nT. Second reference [F3] reports 30 nT magnetic field in magnetic fields and presumably refers to region  $r < 60R$ . The scale of frequencies is same as in plasma sheet and magneto-pause so that the conclusions of the previous section apply.

Despite the low density of protons, the representations based on the harmonics of the cyclotron frequency are in principle possible also inside lobes and the low intensity of experience might explain why proprioception is an almost unconscious sense. The harmonics of the protonic cyclotron frequency define a sequence of representation surfaces inside lobes. These representations result naturally if the projector MEs associated with the personal sensory canvases intersect the magnetic flux tubes. The endogenous magnetic transition frequencies would be associated with heavier molecules with mass numbers around  $A \sim 1500$ . If magnetic lobes contribute to our consciousness, they contribute most probably to consciousness in meditative states. In certain sense "cosmic" consciousness would be in question. The control from this level could be bio-control rather than control of the behavior of an individual organism at conscious level.

In magnetosheath and solar magnetosphere the density of the ions is few ions per cubic centimeter and thus much higher than inside magnetic lobes so that they are better candidates for the seats of sensory representations. Possible are also the representations at the flux tubes of the

interplanetary magnetic field, where the density of ions is few ions per cubic centimeter and thus much higher than inside magnetic lobes.

## 4 Resonant Representations

In this section magnetospheric representations satisfying some kind of resonance condition are studied. One can imagine several resonance mechanisms.

1. The first representation is based on the requirement that ME has length equal to the wavelength corresponding to the magnetic transition frequency so that ME acts as a wave cavity.
2. In the case of magnetic mirror Alfvén waves associated with the magnetic flux tube parallel to ME could provide an additional resonant amplification.
3. The second representation utilizes cavity resonances (in particular Schumann resonances). Even the representations at personal magnetic canvas could utilize this mechanism if personal projector MEs intersect the magnetic flux tubes of Earth's magnetic field.
4. Also spherics associated with lightnings might act as amplifiers.

### 4.1 Hierarchy Of Sensory Representations At Magnetic Mother Gaia

In principle the cyclotron transitions of a given ion with mass number  $A$  in brain could be represented as transitions of any lighter ion with mass number  $A_I$  carried by magnetic flux tubes of Earth's magnetic field. Thus one obtains a hierarchy of representations labelled by the pairs  $(A, A_I)$ ,  $A_I \leq A$ .

1. The magnetic sensory canvas defined by Earth's magnetic field contains certainly protons. The requirement that the ionic cyclotron frequency  $f_p/A$  in brain equals to the protonic cyclotron frequency  $f_p$  at the magnetic flux tube of Earth's magnetic field at distance  $r$  gives in dipole approximation (implying  $1/r^3$  behavior) the constraint

$$\begin{aligned} \frac{r}{R} &= KF(\Theta, \theta) , \\ F &= \left[ \frac{\sqrt{1 - 6\cos(\Theta) + 9\cos^2(\Theta)}}{\sqrt{1 - 6\cos(\theta) + 9\cos^2(\theta)}} \right]^{1/3} , \\ K &= A^{1/3} . \end{aligned} \tag{4.1}$$

The angle dependent factor  $F(\Theta, \theta)$ , where  $\theta$  denotes the polar angle for brain and  $\Theta$  for the point of magnetosphere, comes from polar angle dependence of the magnetic field.  $F(\theta, \Theta)$  varies in the range  $[1/2, 2]$ . The sensory canvases associated with heavier ions are farther away. For  $\theta = \Theta$  (vertical projection) one has  $r/R = A^{1/3}$  and  $A = 20$  gives  $r/R \simeq 2.1$  and  $A = 100$  gives  $r/R \sim 4.6$ .

2. The magnetic flux tubes containing electrons provide second very natural sensory representation. The formula for the distance reads now as

$$K = (m_p/me)^{1/3} A^{1/3} . \tag{4.2}$$

3. Any ion can serve as a representative ion at the sensory canvas and the distance is in general case given by given by

$$K = (A/A_I)^{1/3} . \tag{4.3}$$

The higher the mass number of representing ion at the canvas, the shorter is the distance to the canvas. The increase of the mass of the "brainy" ion means the increase of the distance of the representation.

4. The endogenous variation of flux tube thickness and the deviation of Earth's magnetic field from the exact dipole form implies the generalization of the formula

$$\frac{r}{R} = K \times (B_e/B(r, \Theta))^{1/3} . \quad (4.4)$$

Here  $B_e \sim .5$  Gauss denotes the endogenous value of the Earth's magnetic field whose variation is essential for the frequency coding.  $B(r, \Theta)$  denotes the value of the Earth's magnetic field at given point of magnetic flux tube.  $B_e$  must be distinguished from dark magnetic field  $B_{end} = 2B_E/5 = .2$  Gauss used to explain the findings of Blackman and others. The simplest assumption is that the condition  $B_{end}/B_E = 2/5$  is satisfied quite generally in magnetosphere.

5. Even the ions of macromolecules could drop on the magnetic flux tubes of the endogenous magnetic field so that one could have an onion like hierarchy of sensory canvases labelled by the atomic weight  $A$  of the ion. Cellular size is certainly the upper bound for the size of the ionized structure and for water density this would give the upper bound  $r/R < 10^4 \times R \sim 10^{10}$  meters in protonic case, and  $r/R < 10^{11}$  meters in electronic case, approximately the size of the solar system. Small variations of the ionic cyclotron frequency in brain correspond to the small variations of radial distance at the magnetic sensory magnetic canvas.
6. If one does not allow overlap of the regions of magnetic sensory canvases associated with different ions in brain (mass number  $A$ ) one must have

$$\frac{B_{min}}{B_0} \geq \frac{A}{A+1} \quad \text{or} \quad \frac{B_0}{B_{max}} \geq \frac{A}{A+1} . \quad (4.5)$$

For large values of  $A \sim 100$  this allows one percent variation of cyclotron frequency scale. Actually larger variation is possible since only biologically important ions are involved with the sensory representations.

## 4.2 Endogenous Frequency Fixes The Representation Sphere

The elegance of the place coding by magnetic transition frequency is that the excitation of the frequency corresponding to a given distance automatically stimulates magnetic transition at a correct distance at the sensory canvas. There is only weak dependence on the position of the observer at the surface of Earth even when some fixed structure, say magnetosphere is used to realize the sensory representations. Given frequency determines for given brain a two-dimensional surface (kind of computer screen) of magnetosphere, actually two of them corresponding to different sides of Earth. In some cases the number of this kind of surfaces might be larger.

A given endogenous cyclotron frequency

$$f_m = k \frac{eB_{end}}{m} , \quad (4.6)$$

where  $k$  is a numerical constant, in turn defines a 2-dimensional surface. The harmonics of endogenous cyclotron frequency define a sequence of surfaces with increasing sizes. In the dipole approximation

$$\bar{B} = B(R, \phi = \pi/2) \times \frac{R^3}{r^3} (\bar{e}_z - 3\cos(\Theta)\bar{e}_r) , \quad (4.7)$$

the harmonics of the cyclotron frequency this sequence is given by

$$\frac{ke}{m} B(R, \pi/2) \times \frac{R^3}{r^3} \times \sqrt{1 - 6\cos(\Theta) + 9\cos^2(\Theta)} = f_{end} = n f_m , \quad (4.8)$$

which are obtained by the scaling  $r \rightarrow n^{-1/3}r$  from  $n = n_{min}$  surface. This scaling property holds quite generally and for transitions involving spin flip the scaling factor changes from  $n^{-1/3}$  to  $(n + \Delta)^{-1/3}$ . The distance between subsequent surfaces behaves as  $1/n^{4/3}$  and becomes small for large values of  $n$ . Note however that finite range  $[n_{min}, n_{max}]$  of values for  $n$  is possible. By varying the endogenous magnetic field the scale of the cyclotron frequency can be varied.

In magnetic lobes and plasma sheet the dipole approximation fails badly. Inside plasma sheet the representing surfaces are in a good approximation sheets parallel to plasma sheet. Magnetic field strength varies  $B_E$  from  $\sim 10$  nT to  $\sim 20$  nT from the interior of sheet to the exterior of sheet so that one octave of frequencies is still representable also for  $B_{end}$  by the basic assumptions. These sheets appear as northern-southern degenerate pairs. This brings in mind the left-right degeneracy of the sensory representations at the level of brain. The hypothesis that left and right brain hemispheres project to opposite magneto-hemispheres is at least worth of studying. Resonance at the fundamental frequency of the projector ME is possible only if the representation is realized at very long distance: for an electronic cyclotron spin flip the resonance distance would be  $272R$  and for proton cyclotron resonance  $817R$ .

Note that also the representations below Earth's surface must be considered since projector MEs should be able to penetrate the Faraday cage defined by Earth's surface (the cage is associated with atomic space-time sheets only). These high frequency representations might be also relevant.

### 4.3 Projector MEs As Wave Cavities

EEG contains several resonances frequencies and the most natural explanation for them is as resonances in a wave cavity defined by ME having length equal to the resonance wavelength defined by the endogenous magnetic transition frequency. The nice aspect of this representation is the possibility of resonant amplification of the EEG signal.

#### 4.3.1 Resonance conditions

Projector MEs could be reflected from the flux tubes of Earth's magnetic field at distance  $L$ , which at resonance of  $n$ : th order is integer multiple  $nL_m$  of the magnetic transition length  $L_m = c/f_m$ , where  $f_m$  represents a variable endogenous magnetic transition frequency:

$$L = nL_m = \frac{c}{f_m} . \quad (4.9)$$

Thus the sensory canvas for a given frequency is a subset of a brain centered sphere of radius  $L_m$

$$|\bar{r} - \bar{r}_{brain}| = L = nL_m . \quad (4.10)$$

The intersection of this surface with the sphere surrounding the brain defines 1-dimensional curve where the resonance occurs. For large values of  $L = nL_m$  the conditions do not have any solutions at all. This is clear from the fact that  $L$  behaves like  $r^3$  whereas  $|\bar{r} - \bar{r}_{brain}|$  behaves as  $r$  and grows much slower. Thus solutions can be found only for sufficiently high endogenous frequencies representable as high harmonics of the cyclotron frequencies at the magnetic canvas.

##### 1. The situation in which longitudinal momentum increment vanishes

If the magnetic transition is such that one can neglect the increment of the longitudinal momentum of the representing particle, one obtains a set of one-dimensional curves labelled by the pairs  $(n_c, n)$  of integers. Each harmonic  $n_c$  of the cyclotron frequency gives rise to a set of closely spaced one-dimensional curves on the corresponding sphere. The variation of the endogenous cyclotron frequency scale implies that a set of two-dimensional surfaces close to each other is obtained. For large values of  $n$  this gives quite good representation for the sensory canvas although the quantization of 3-dimensional volume to 2-dimensional surfaces is unavoidable. From the point of view of information processing this compression of information is desirable.

For a given cyclotron harmonic  $n_c$  one can get a good grasp about the situation by solving  $n_c$  from the resonance condition when projector ME is vertical:

$$n_c = \frac{2\pi f_s}{f_c(r=R, \theta)} \frac{x^3}{x + \epsilon} \rightarrow \frac{2\pi f_s}{f_c(r=R, \theta)} x^2, \quad x \rightarrow \infty. \quad (4.11)$$

$\epsilon = \pm 1$  refers to the representation at the same/opposite side of the globe. For large values of  $x$  one has  $n_c \propto x^2$  so that the distance behaves like the radius of a Bohr orbit for a quantized harmonic oscillator.

In the plasma sheet the time averaged magnetic field is constant equal to  $B_E \sim 10$  nT. The harmonics of a given cyclotron frequency  $f_c = qB/2\pi m$  define a series of octave wide representations at the plasma sheet. The distance  $r$  associated with a given cyclotron frequency is given by the resonance condition as

$$x \equiv \frac{r}{R} = -\epsilon + \frac{k}{n_c}, \quad k \equiv \frac{2\pi f_s}{f_c}, \quad (4.12)$$

where  $f_s = c/2\pi R = 7.8$  Hz is Schumann frequency.  $\epsilon = \pm 1$  corresponds to the representations at the same/opposite side of the globe. The condition  $8 \leq x \leq 60$  gives the bounds  $k/(60 + \epsilon) \leq n_c \leq k/(8 + \epsilon)$  for  $n_c$ . For instance, for proton the allowed range of harmonics is  $13 \leq n_c \leq 90$ .

### 2. Taking into account the increment of longitudinal momentum

The previous discussion is oversimplified in that it does not take into account the increment of the longitudinal momentum of the representing particle. The ions at the magnetic flux tubes have also kinetic energy  $E = k^2/2m$ ,  $\hbar = 1$  associated with the longitudinal motion (this is indeed the case for the magnetic flux tubes of Earth's magnetic field). The possibility that the longitudinal kinetic energy of large number of ions changes in the magnetic quantum phase transition simultaneously brings in an additional degree of freedom, which replaces the discrete curve associated with a given endogenous frequency with a set of curves.

In this case the formula for  $n_c$  (assuming that the projector is in the vertical direction) generalizes to

$$n_c = \left[ 2\pi f_s \frac{1}{x + \epsilon} - \frac{\Delta k^2}{4\pi m} \right] \frac{x^3}{f_c(r=R, \theta)}. \quad (4.13)$$

Clearly the variation of  $k$  allows variation of  $x$  characterizing the length of ME.

The effective continuity of the new degree of freedom is not guaranteed since the value of the momentum  $k$  is quantized to the multiple of  $k_0 = \pi/l$ , where  $l$  is the length of the magnetic flux tube, just as in the case of the Alfvén waves so that one might expect a coupling of super-conducting particles to Alfvén waves to be present. The representation with a given endogenous frequency becomes effectively continuous and thus two-dimensional if the condition

$$\frac{\Delta k^2}{2m} \simeq \frac{2k\Delta k}{m} \ll n f_c \quad (4.14)$$

holds true. This implies that the representation obtained by varying the endogenous frequency becomes effectively 3-dimensional.

The quantization of the longitudinal momentum implies that the condition is not trivially satisfied and requires

$$E_{||} \ll \pi n_c f_c. \quad (4.15)$$

For energetic ions and electrons the new degree of freedom is still more discrete than that associated with cyclotron frequency (recall that cyclotron energy scale is extremely low).

For highly relativistic particles (say electronic Cooper pairs in outer radiation belt with energies up to 10 MeV) with energy higher than the rest mass, the longitudinal kinetic energy is in a good approximation given by  $E_{||} = n_{||}\pi c/l$  and in this case the effective condition reduces to  $l \gg L$ , which is satisfied in a reasonable approximation. Thus electronic radiation belts could give rise to effectively 2-dimensional representations whereas nearby representations in the ionosphere and protonic representations would be one-dimensional. In particular, 40 Hz protonic representations would be one-dimensional.

### 4.3.2 Can one understand basic facts about sensory representations?

The basic prediction is that resonance representations are effectively three-dimensional if the increment of the longitudinal kinetic energy of the ions is small in the magnetic transition and if the endogenous frequency varies. If the increment of the longitudinal energy is not possible, the representations are 2-dimensional and reduce to 1-dimensional if endogenous frequency does not vary. In general case one obtains actually a sequence of representation surfaces with effectively quantize 3-space to a collection of 2-dimensional surfaces.

Brain indeed contains two-dimensional representations: consider only the somatosensory maps of skin. Also the visual information from retina is two-dimensional and the objects of the visual field are represented as two-dimensional surfaces. The 3-dimensional visual field could result as a high level construct but it is not at all obvious whether genuinely three-dimensional representations are really needed. The compression of information implied by discretization might be more useful than faithful 3-dimensional representation.

Many fundamental features (such as edges, lines, triangles, circles) in the sensory representations of brain seem to be one-dimensional. Quantum entanglement between various levels in the hierarchy of sensory representations allows modularity so that an object of a lower level representation can be assigned to a point of a higher level sensory canvas. Low level representations, say 40 Hz representation at primary sensory areas are two- or one-dimensional depending on whether the endogenous frequency varies or not. By quantum entanglement these one- or two-dimensional features might be associated with higher level representations which might be non-resonant and thus genuinely two or three-dimensional representation for the positions of the perceptive field.

### 4.3.3 Could also Alfven waves be involved?

A further interesting point is related to the Alfven waves. Alfven waves are a somewhat phenomenological concept based on the notion of field line resonance (FLR). The idea is to treat field line as a system analogous to a violin string so that the frequencies of the modes are given by  $\omega = nk_{||}$ ,  $k_{||} = n\pi/L$ , where  $L$  is the length of the field line. Whether Maxwell's equations really allow FLR concept has been questioned [F16].

Amusingly, it seems that Alfven's intuition might have gone far beyond Maxwell's theory. In TGD framework FLR modes correspond to the oscillation modes of the magnetic flux tubes and are very similar to the massless modes associated with strings (see the appendix). For straight flux tubes parallel MEs with same length as the magnetic flux tube would couple to the FLR modes resonantly and the ends of the magnetic flux tube would act as a pair of mirrors. This resonance mechanism might be crucial for the representations at the personal magnetic sensory canvas.

Also curvilinear MEs are possible but it is not clear whether the general solution ansatz for MEs allows also curvilinear MEs so that any flux tube would couple resonantly to parallel MEs. In this case the resonance condition would state that the length from brain along the magnetic flux tube to the representation point equals to the wavelength associated with the magnetic frequency at the representation point. This would allow to widen the representational repertoire to lower frequencies.

## 4.4 Sensory Representations Appear As Night-Day Conjugate Pairs

MEs should penetrate the Faraday cages defined, not only by the low boundary of ionosphere, but also by Earth itself. This means that it is possible to have sensory representations at the other side of the globe. As found, resonance conditions for the representation points at the same side of the globe do not have solutions for too low values of the magnetic transition frequency since the sphere associated with the observer is so large that it does not intersect the magnetic transition frequency = constant surface. One can however improve the situation by allowing the representation at the other side of globe. Thus representations come as pairs: a high frequency representation at the same side of Earth as the observer and a conjugate low frequency representation at the other side of the globe.

One can derive the lower bound for the resonance frequencies by simply noticing that the degenerate cases for the sensory representations correspond to a situation in which the vector  $\vec{r}$  of the point of the sensory canvas and the vector  $\vec{r} - R\vec{e}$  from the brain to the point of the sensory canvas are parallel. In this case representation point is vertically above the brain and the length



of the ME determined by the endogenous transition frequency equals to the magnetic transition frequency in Earth's magnetic field. These two extremes define the frequency range which is representable for a given representative ion with atomic weight  $A_I$  and represented ion  $A$ .

In order to gain insight it is useful to study a simplified example idealizing Earth's magnetic field strength behaves strictly as  $1/r^3$ . If one requires that the length of the projector ME is same as the distance of the activated magnetic flux tube from the surface of Earth, one obtains a condition for the ratio  $A/A_I$ . The vertical distance  $d$  from the surface of Earth to the flux tube would be given by

$$d = R((A/A_I)^{1/3} - \epsilon) , \quad (4.16)$$

whereas the length of ME is under simplest assumption cyclotron wavelength  $\lambda_c = A/f_p$ .  $\epsilon = 1/-1$  holds true for the representation point at the same/opposite side of the globe.

This gives the conditions

$$\frac{[(A/A_I)^{1/3} - \epsilon]}{A} \times \frac{f_p}{2\pi f_s} = 1 . \quad (4.17)$$

Here  $\epsilon = 1$  corresponds to the representations at same side of globe and  $\epsilon = -1$  to the representations at the opposite side of the globe.  $f_p/2\pi f_s \simeq 6.1$  holds true for  $B = .5$  Gauss. The condition selects proton ( $A_I = 1$ ) as optimal for the sensory representations.

#### 4.4.1 Protonic and atomic cyclotron transitions

The numerical study of the condition of Eq. 4.17 in the case of proton demonstrates that the protonically representable frequency range is 12.5 – 100 Hz and thus contains beta and gamma bands but not the lower bands. This conforms with the fact that only these bands seem to correlate directly with our sensory and cognitive consciousness (note that these representations presumably correspond to our memories). Na ( $A = 13$ ) corresponds to the lower end of the spectrum and tritium ( $A = 3$ ) to the upper end of the spectrum. Li ( $A = 7$ ) and possibly  $O^{--}$  ( $A/Z = 8$ ) correspond to 40 Hz resonance band. Of course, these considerations are only order of magnitude considerations and the weak directional dependence of the magnetic field strength has been neglected. The homeostasis of the endogenous magnetic field does not help to satisfy the condition since the replacement  $B \rightarrow xB$  only means the replacement  $A \rightarrow A/x$  in the formula above.

Higher harmonics of the proton cyclotron frequency suggest a possibility to widen the representational repertoire to include alpha band perhaps even theta band.  $n = 3$  cyclotron transition allows the range (7.0 – 12.5) Hz ranging from Ca to Mg. In this case however the distances are of order  $r = 6R$  so that dipole approximation fails and the conclusion about the representability of alpha band are somewhat questionable.

${}^4He^{++}$  ( $A_I/Z = 2$ ) ion provides a second candidate for sensory representation. This representation allows ions with  $A \leq 19$  (F) and cyclotron frequencies above 15.8 Hz.  ${}^4He^+$  ( $A_I/Z = 4$ ) ion provides a third candidate for sensory representation in this case oxygen ( $A=16$ ) with cyclotron frequency 17.8 Hz is the heaviest representable molecule. It is obvious that when  $A_I$  increases the molecular weight of the heaviest representable molecule decreases.

#### 4.4.2 Electronic transitions

Electronic cyclotron spin flip transition provides a second natural candidate for sensory representation. Since the frequency is 902 Hz it corresponds to  $n = 3$  cyclotron transition for proton and effectively to  $A_I = 1/3$ . In this case the representable frequency range is (8.6 – 18.8) Hz and contains also alpha band. The lower end of the spectrum corresponds to  $Cl^-$  ( $A = 35$ ) and the upper end to  $O^+$  ( $A = 16$ ), which are thus only marginally representable. The representable frequency range corresponds to frequencies above 18.8 Hz.

For the electronic cyclotron transitions for which one effectively has  $A_I = m_e/m_p$ , the distance from the point of the magnetic sensory canvas is in general much longer than the minimal length

of ME so that ME frequencies must correspond to higher harmonics of the fundamental frequency  $c/L$ . The frequencies are above 2.7 kHz for  $r < 6R$  in dipole approximation. Electronic cyclotron transitions could provide a representation of audible frequencies above kHz whereas cyclotron spin flip frequencies would represent audible frequencies below 1 kHz.

One could consider also the possibility of a sensory representation based on magnetic flux tubes of the interplanetary magnetic field. The strength of magnetic field varies in the range .2 – 80 nT with average value around 6 nT. For electronic cyclotron transition the corresponding frequency range is 2.4-960 Hz with the length of projector ME varying in the range  $20.4 - .05R$ . 6 nT corresponds to 7.2 Hz corresponding to length  $6.8R$  of projector ME. Thus also theta and delta band are included. Since the average solar magnetic field is constant it should be possible to find a point outside magnetosphere for which the resonance condition is satisfied. For protonic representations the frequency scales are scaled down by a factor  $2^{-11}$  and could be also realized but now the distance range is scaled up by a factor  $2^{11}$  and this means that distances are at least of order 100R. During sunspot maxima this contribution to consciousness should be maximal but also shifted to frequencies higher than 7.2 Hz.

#### 4.4.3 Thalamocortical resonance band and magnetospheric sensory representations

The sounds produced by meteors are in the thalamocortical resonance range 37.5 – 43.0 Hz instead of the expected range  $20 - 2 \times 10^4$  Hz for sferics and much stronger than expected and strongly dependent on position and the direction of meteor [F14]. This encourages the explanation in terms of resonances associated with the projector MEs at 40 Hz band emerging from brain and also from inorganic matter (sounds were recorded also electronically) and acting as amplifying wave guides [K7] ).

In light of this thalamocortical resonance band which is excellent candidate for the cyclotron frequencies associated with the magnetospheric sensory representations at primary sensory areas. The resonance range is indeed bounded by  $A = 8$  and  $A = 7$  cyclotron frequencies (37.5 Hz and 42.9 Hz). There are two options.

1. Thalamocortical representation could be associated with Cooper pairs of  $Li^+$  ions having  $A = 7$ . Endogenous magnetic fields would vary in the range  $(7/8, 1) \times B_0$ ,  $B_0 = .5$  Gauss, for this representation. The predicted 12.5 per cent variation is consistent with the general  $\sim 10$  per cent relative variation of EEG frequencies. That lithium acts as an antidepressant might relate to its role in generating sensory representations.
2.  $O^{--}$  ions or doubly ionized water molecules ( $A/Z = 8$ ), perhaps resulting when the  $OH$  bonds of a water molecule split, are second option. Note that doubly ionized oxygen is boson as is also  $Ca^{++}$  ion. In this case endogenous magnetic fields would vary in the range  $(1, 8/7) \times B_0$ , which means 14 per cent relative variation of the cyclotron frequency.

Both  $Li^+$  and  $O^{--}$  could be involved and be related to the sensory representations of the interior milieu (world as it feels) and external world (world as experienced in the third person perspective). In [K13] it is suggested that these two representations are separated by blood-brain barrier and are realized by sensory projectors emanating from red blood cells and pyramidal cells respectively (both cells contain magnetic structures).  $O^{--}$  would be associated with red blood cells whereas  $Li^+$  would relate to the pyramidal cells.

## 4.5 Representations Based On Cavity Resonances

Various resonances associated with the magnetosphere might help to amplify the cyclotron frequencies represented by MEs. There is indeed a rich repertoire of various oscillation modes associated with the magnetosphere. Being not a specialist, I can mention only the most obvious examples. Various structures defined by Earth and magnetosphere define a hierarchy of space-time sheets and the cavity resonances of the classical fields associated with are the most obvious candidates for amplification purposes. Cavity resonance frequencies could be same or very nearly same for both classical em and  $Z^0$  fields. This is certainly the case if large space-time sheets can carry both electromagnetic and  $Z^0$  fields simultaneously.

In many-sheeted space-time framework also the cavity resonances associated with the space-time sheets of Earth and Earth's inner and outer core plus possible other substructures such as ionospheric cavity and the thin cavities defined by boundary layers must be considered since the matter is at the atomic space-time sheets and the space-time sheets in question are practically empty of particles and could be super-conducting. Effective surface resonances have higher overall frequency scale (by the classical counterpart of Uncertainty Principle) than interior cavity resonances. Schumann resonances (for a detailed treatment see the appendix) are almost surface resonances because the surface layer involved is so thin. Also a well-defined dimensional reduction can occur. For Schumann cavity the lowest frequency is 10.6 Hz, which is essentially the frequency of the alpha peak and quite near to the basic frequency of the memetic code.

The hierarchy of space-time sheets would thus correspond to the hierarchy of potential resonance frequencies in EEG corresponding to the radii of Earth's inner core and outer cores, Earth's radius, ionosphere, the size of the magnetosphere, the sizes of the structures in the magneto-tail, etc...

#### 4.5.1 Schumann resonances and resonances associated with inner and outer core of Earth

Schumann resonances are usually identified as cavity resonances associated with the cavity between Earth's conducting surface and the lower boundary of ionosphere. Also in TGD cavity resonances should be very much like the resonances for the ordinary Maxwell fields. Coupling of MEs with Schumann resonances provides a possible manner to achieve amplification even when the length of ME does not satisfy the resonance condition.

The nominal values of the Schumann resonance frequencies are 7.8, 14, ...39, 45, ... Hz and many of these frequencies are important resonant frequencies of EEG which suggests that this amplification mechanism is indeed utilized. Numerical estimates demonstrate that radiation belts containing the ring currents are especially interesting seats of representations amplified (also) by Schumann resonance. Dipole approximation for the magnetic field should be reasonable at the distance corresponding to the maximum of the ring current. Flux maxima are also good candidates for seats of sensory representation.

1. The flux maximum for the protons in the inner belt is at  $2R$ . The cyclotron frequency of proton is 37.5 Hz at this distance and corresponds to the lower limit of 40 Hz thalamocortical resonance band and is quite near to Schumann frequency 39 Hz. Note that in this case the resonance condition based on the length of ME can be also satisfied.
2. At the outer electronic belt extending to  $6R$  electronic ring current dominates and is maximum at  $4R$ : the cyclotron spin flip frequency for electron scales which is 902 Hz for  $B = .5$  Gauss scales down to 14 Hz, which corresponds to sleeping spindles, sensorymotor resonance frequency, and to the second Schumann resonance, and is also near to the endogenous  $Na^+$  cyclotron frequency 13 Hz. In the electronic case the distance condition is not possible to satisfy unless the representation is realized at the other side of the globe. Note that sleeping spindles could also correspond to control action (now lullaby!) exercised from the outer radiation belt.
3. Also the endogenous cyclotron frequencies sufficiently near 7.8 Hz could be represented as protonic cyclotron transition using Schumann resonance. The lowest Schumann resonance is probably relevant for hypnagogic states. Personally I sometimes experience during hypnagogic periods what it is to be quite another person. If Schumann resonance is in question, the interpretation would be that magnetic Mother Gaia experiencing us as sub-selves and sharing of mental image is in question. T

The distance for 7.8 Hz protonic cyclotron frequency is  $3.4R$  in dipole approximation whereas the length of ME would be  $6.3R$ . For the representation at the opposite side the distance would be below  $5.4R$  so that Schumann resonance is the only possible manner to achieve the amplification. For the third harmonic of the protonic cyclotron frequency the lower bound for the resonant amplification by ME is 8.6 Hz and rather near to the lowest Schumann resonance. The absence of the resonant amplification by projector ME wave cavity could explain why hypnagogy is unmasked only when the sensory input is absent. Note that the biologically important ions  $K$  and  $Cl$  have cyclotron frequencies near the lowest Schumann resonance.

In many-sheeted space-time also the cavity resonances associated with Earth's inner and outer core could be important. For the inner solid core of Earth having radius of 1200 km the counterpart of the lowest Schumann frequency is 41.4 Hz. The outer liquid core has radius 2900 km and in this case the lowest Schumann frequency is scaled up to 14.3 Hz, which is near to the sensorimotor resonance frequency and sleeping spindle frequency. Both of these frequencies are important resonance frequencies in EEG (and should be so in ZEG) and almost coincide with Schumann frequencies. Even more, the mantle above the outer core divides into two parts. The boundary is at the depth of 1000 km: the corresponding cavity frequency is 9.25 Hz and in the accuracy used equal to the lower bound of  $Z^0$  cyclotron frequency varying in the range 9.3 – 11.4 Hz.

#### 4.5.2 Cavity resonances in the magnetic lobe

Various oscillation modes associated with cavities like the inner magnetosphere and entire magnetosphere could also serve as resonant amplifiers of the signals carried by the projector MEs involved with sensory representations.

In particular, lobe cavity with length  $L \sim 10^3 R$  gives rise to electromagnetic oscillation modes in the direction of the lobes with the spectrum of frequencies having fundamental frequency of about  $f = c/L = c/10^3 R \sim 49$  mHz. A repeated reflection between magneto-pause and magneto-tail ( $r \sim 20R$ ) would give resonance frequency 2.45 Hz whereas the repeated reflection between the opposite sides of magneto-pause ( $r \sim 40R$ ) would give 1.23 Hz resonance frequency. These are of course only rough order of magnitude estimates. These modes might be involved with the amplification of the frequencies in delta band.

The frequencies of the night side auroral Pc5 pulsations are quantized as multiples of 0.9, 1.3, 1.95, 2.6, and 3.3 mHz [F11]. They have been interpreted as field line excitations (FLR) excited by quantized compressional modes. TGD inspired explanation for the Pc5 pulsations would be following. The reconnection process excites the Alfvén waves associated with the flux tubes of the solar magnetic field. The distance to the Sun is  $L = 8$  light minutes, that is  $L = 2.9 \times 10^{11} R$ . The fundamental frequency is  $f = c/L = 1.1$  mHz and indeed of the same order of magnitude as the frequencies assigned with the compressional modes. If compressional waves are there, they could excite the FLR excitations of the solar magnetic field or vice versa. If solar magnetosphere is conscious self it could control Earth magnetosphere by exciting these modes (solar magnetosphere is known to have “memory”: the complex magnetic structure return to the original one after 11 year sunspot period [E2]).

#### 4.5.3 Delta band cavity resonances and epilepsy

Sferics are electromagnetic excitations associated with lightnings. Some authors define the frequency spectrum of sferics roughly  $20 - 2 \times 10^4$  Hz, which corresponds to the range of audible frequencies (this is perhaps not an accident). Some authors define sferics as the frequency range  $0 - 2 \times 10^4$  Hz.

The spectrum of sferics defined in the latter sense has a maximum at 3 Hz and spectrum resembles EEG spectrum in this region. A possible interpretation of the delta band peak is in terms of the cavity resonances. The general scale of the inner magnetosphere is about  $4R$  so that one would expect by scaling from Schumann resonance frequency  $f \sim 7.8/4 = 1.95$  Hz for the fundamental frequency. Also the previously mentioned resonances with frequencies are 1.25 Hz and 2.5 Hz (rough estimate) associated with the radial degrees of freedom inside magneto-tail contribute to delta band. Since the plasma sheet becomes thicker and the magneto-tail gets thinner near Earth, one expects that the fundamental frequency increases for the local reflection modes from the rough estimate 2.5 Hz so that also 3 Hz frequency should belong to the spectrum.

These cavity resonances could amplify delta band around 3 Hz. That petit mal begins with the amplification 3 Hz EEG rhythm might relate to the resonant amplification by sferics. For proton 3 Hz corresponds to  $r = 4.6R$  and for electron to  $r = 6.7R$  and resonance condition for ME gives the distance  $d = 16R$  which is in the outer magnetosphere. Here higher harmonics of proton cyclotron frequency would allow a resonant amplification. A loss of consciousness could result from the entanglement of entire self. The alternative option is that only mental image is entangled so that consciousness is not lost but that there is no memory representation about the

$x = d/R$	1	2	3	4	5	6	8	10	60	$10^3$
$f/Hz$	49.0	24.5	16.3	12.3	9.8	8.2	6.1	4.9	0.8	.05
$y = r/R$	1	2	3	4	5	6	8	10	60	$10^3$
$f_p/Hz$	300	37.5	11.1	4.7	2.4	1.4	0.06	0.06	0.06	0.06
$f(e)/Hz$	902	112.8	33.4	14.1	7.2	4.2	0.18	0.18	0.18	0.18
$f_e(Z^0)/Hz$	707	88	26	11	5.7	3.3	0.14	0.14	0.14	0.14

**Table 1:** The first two rows give the dependence of the fundamental frequency  $f = c/d$  of ME projector on its length  $d$ . The next rows give the dependence of of proton's cyclotron frequency  $f_p$ , electron's cyclotron spin flip frequency  $f(e)$ , and electron's  $Z^0$  cyclotron frequency  $f_e(Z^0)$  on the distance  $r$  from Earth's center. On outer magnetosphere the consideration is restricted to the plasma sheet. Earth's magnetic field of 10 nT is assumed in the plasma sheet above  $r = 8R$  and below this distance dipole approximation neglecting polar angle dependence is used. Cyclotron frequencies are calculated for endogenous magnetic field  $B_{end} = 2B_E/5$ : the reasons for a little bit strange representation are discussed in introduction.  $Z^0$  magnetic field is assumed to be related to magnetic field by scaling  $g_Z B_Z = eB/16$ .

conscious experience during the epileptic seizure (the situation would be same in the case of sleep state).

## 5 The Hierarchy Of Magnetospheric Representations

In the sequel magnetospheric representations and their interpretation are discussed in a more detail. The basic vision is that a hierarchy of selves extending up to the scales of lightlife can contribute to our own conscious experience. The mechanism generating sensory and motor representations would be the intersection of the magnetic mirrors associated with the personal sensory canvas with various magnetic flux tube structures of the magnetosphere. An essential correction to the earlier representation is that the frequencies correspond to  $B_{end} = 2B_E/5$  ( $= .2$  Gauss at Earth surface) rather than the Earth's magnetic field  $B_E$ . There reasons for this are explained in the introduction.

### 5.1 EEGAnd Magnetospheric Sensory Representations

Resonance condition at lowest order gives extremely strong restrictions on sensory representations. These condition become even more stringent if one assumes that only the fundamental frequency  $f = c/L$  of ME projector is of significance. The **Table 1** gives an overall view about how the frequency depends on the length of ME and allows to understand the implications of these conditions. An especially interesting consequence of the resonance condition is that audible frequencies must be represented inside brain as features and entangled to the sensory magnetic canvas rather than being directly coded to em or  $Z^0$  frequencies.

#### 5.1.1 Magneto-tail represents delta and theta bands

If the higher harmonics of the fundamental frequency  $f = c/L$  of ME are *not* significant, one can deduce following conclusions about the representations in the magneto-tail.

1. The range of frequencies representable for projector lengths  $d < L_t = 60R$ , where  $L_t$  corresponds roughly to the distance to the tip of the plasma sheet (neutral point), contains frequencies between  $f_{min} = .8$  Hz and  $f_{max} = 8.1$  Hz and thus covers delta and theta bands. Perhaps it is not a mere accident that  $f_{min}$  defines a natural lower boundary of the delta band.
2. The lowest frequency representable inside the magneto-tail ( $r < 10^3R$ ) is  $f_{p,tail} = .049$  Hz which corresponds to a period of 20.4 seconds:  $f_{p,tail}$  is rather near to the protonic cyclotron frequency  $f_p$  inside plasma sheet.

$f$	$f_d/Hz$	$f_u/Hz$
$f_p$	12.5	100
$f(e)$ and $3f_p$	8.6	18.8
$5f_p$	7.0	12.5
$7f_p$	6.1	10.0
$f^4_{He}$	15.8	75
$f_e(Z^0)$	9.4	25.0

**Table 2:** The allowed electronic frequency bands and cyclotron bands proton and  $^4He$ .

- Higher harmonics of  $f_p$  can be used to widen the representational repertoire at distances, where  $f > f_p$  condition holds true. The  $n$ : th harmonic of  $f_{p,tail}$  defines an octave wide representation and distance  $r_n = r_{max}/n$ . Same applies to the harmonics of the electronic  $Z^0$  cyclotron frequency  $f_{e,tail}(Z^0) = .14$  Hz.
- The frequencies which are lower than  $f_{tail}$  must be represented as magnetic transition frequencies in the heliosphere. Most naturally at the night side, where the solar magnetic field weakens with distance.

### 5.1.2 Inner magnetosphere represents alpha, beta and gamma bands

The lowest frequency representable inside the inner magnetosphere ( $r \leq 4R$  at the day side,  $r \leq 6R$  at the night side) is 12.5 Hz at day side and 8.6 Hz at night side: theta and delta bands are excluded at the night side and at the day side also alpha band is excluded.

By applying the constraints for the representations at the same and opposite side of the globe to the electronic case one obtains the following results: also proton and  $^4He$  are included for the sake of comparison.

The allowed electronic frequency bands and higher protonic cyclotron bands are rather narrow. For  $Z^0$  cyclotron frequency higher harmonics allow to reduce the lower bound but  $n > 3$  harmonics lead out of the inner magnetosphere. Even harmonics are expected to define much weaker cyclotron quantum phase transitions because of parity conservation in lowest order. The only exception is formed by frequencies near the maximum frequency 902 Hz *resp.* 707 Hz representable locally:  $d \sim 300$  km  $\ll R$ . For  $Z^0$  electronic representation also harmonics can be represented.

### 5.1.3 Audible frequencies allow magnetospheric representation only if higher harmonics of ME projector frequencies are allowed

Mother Gaia should also hear and speak so that auditory experience should have representation at the sensory magnetic canvas and control of speech should be possible to some degree from magnetosphere. From the foregoing it is clear that the spectrum of audible frequencies does not allow resonant magnetospheric representation unless one allows higher harmonics of the fundamental ME frequency  $f = c/L$ .

The first possibility is that audible frequencies are represented as features inside brain and quantum entangled to the points of both magnetospheric and personal sensory canvases. Also motor representations provided by sensory canvases could be high level representations involving only frequencies below 26 Hz (roughly the limit of audible frequencies) and perhaps identifiable as internal speech. This idea conforms with the view that motor actions are like four-dimensional fractal statues carved quantum by quantum jump by adding further details in increasingly shorter time scales. TGD based quantum model for hearing indeed assumes a local representation inside brain based on ‘‘cognitive’’ neutrinos: the model predicts correctly the upper bound of audible frequency [E1] [K24].

The situation changes if higher harmonics for projector MEs are allowed. The range for audible frequencies is  $20 - 2 \times 10^4$  Hz. This frequency range corresponds to that of sferics [F6] and sferics might act as amplifiers of the signals between brain and  $Z^0$  sensory canvas.

1. *Place coding of frequencies of speech and sounds*

Electron spin flip transition corresponds to frequency 33 Hz at  $r = 3R$  and varies up to 900 Hz below this height. This would suggest that electron spin flip might place code for the frequency range between 33 – 900 Hz. Also protonic spin flip,  $n = 3$  protonic cyclotron transition, and protonic spin flip plus cyclotron transition could be considered as translating sound frequencies to em frequencies in this frequency range.

Only the representations as electronic cyclotron transitions is possible above  $10^3$  Hz. Electronic cyclotron frequency is .564 MHz in the magnetic field of  $B_{end} = .2$  Gauss. The magnetic field  $B_{end} = 2B_E/10 = 4$  nT for  $B_E = 10$  nT at plasma sheet corresponds to a frequency of 112.8 Hz. At a distance of  $r = 8R$ , where plasma sheet begins, the frequency is 1.1 kHz. At  $r = 3R$  it is  $2 \times 10^4$  Hz. Thus the audible frequencies above kHz could be represented as electron cyclotron frequencies inside the night side inner magnetosphere at personal magnetic body with  $B_{end} = 2B_E/5$ .

From the foregoing it is clear that the frequency of 1 kHz is in a special role. This frequency is a remarkable frequency also in many other aspects.

1. The duration of single bit of the memetic code word is near to one millisecond.
2. The sound wavelength corresponding to 1 kHz is corresponds to the head size: above these frequencies sounds can be treated using geometric acoustics and below this frequency diffraction effects are important: for instance, the mechanism allowing to decide the direction of sound is different above and below 1 kHz.
3.  $\sim 1$  kHz is also the frequency neuronal synchrony.

### 2. Memetic code and speech

The harmonics of electron's  $Z^0$  cyclotron frequency could be involved with the motor control of speech. The same mechanism provides an alternative coding of speech frequencies below  $\sim 1$  kHz.

1. With the assumptions made about  $Z^0$  magnetic field ( $g_z B_Z = eB/16$ ), the representable range for  $f_e(Z^0)$  is (.14 – 707) Hz, if only the lowest cyclotron harmonic is allowed. These transitions might relate to the control of speech using memetic code. The resonantly representable frequency range (9.4, 25) Hz indeed contains memetic code frequency and  $r = 4.2R$  corresponds to the frequency 9.9 Hz: this distance corresponds to the maximum of the electronic flux.
2. All atomic (hydrogen atom forms an exception) and molecular  $Z^0$  cyclotron frequencies are in the range (9.4, 11.3) Hz in endogenous  $Z^0$  magnetic field. That the lower bound is same as for resonantly representable frequencies is to some degree a miracle.  $Z^0$  MEs from  $Z^0$  magnetospheric motor area could thus be responsible for the generation of speech. The fact that the cyclotron frequencies of all atoms and molecules are nearly identical might make possible effective amplification of  $Z^0$  signal in the body and head to internal speech and possible even real sound by  $Z^0$  piezo-electric effect. In accordance with the earlier speculations,  $Z^0$  MEs could be also responsible for internal speech which would be analogous to an imagined motor action.
3. The harmonics of  $\sim 10$  Hz frequency defining the duration of memetic codon are natural candidates for the frequencies appearing in the representation of the memetic codewords as fast amplitude modulation of the basic frequency  $\sim 10Hz$ . What this means that higher harmonics add a small ripple to the basic oscillation. The higher harmonics of the cyclotron frequency  $f_e(Z^0) \sim 10$  Hz up to  $126^{th}$  harmonic would provide the coding of the memetic code words of duration .1 seconds representing basic information units of speech (perhaps phonemes). The duration of a single bit is of order one millisecond and coincides with the typical duration of the nerve pulse. Actually the number of harmonics needed is vanishingly small as compared to the maximum number 126 since the number of phonemes is much smaller than the maximal number  $2^{126} \sim 10^{38}$ . Hence brain utilizes only vanishingly small part of the resources allowed by the memetic code.

What looks nice is that the difference between inner speech and actually heard speech would reduce to the difference between em and  $Z^0$  interactions. These considerations raise the question who is really expressing itself when I am speaking: me or Mother Gaia or some of its many sub-selves? To speak fluently is to let it go and it might be that magnetospheric selves are also expressing themselves when this happens.

#### 5.1.4 What the emergence of the oxygen belt could mean?

Interestingly, during the last decade two sub-belts have emerged inside the inner radiation belt [J1]. The first belt is electronic and at  $r \sim 2R$ . The second newcomer contains mainly  $O^+$  ions. If the  $O^+$  flux has maximum at  $r = 2R$ , this would mean the appearance of new strongly represented cyclotron frequency of about  $f_{O^+} = 2.3$  Hz for  $B_{end}$ , and perhaps a new delta band contribution to the magnetospheric consciousness (and perhaps even to our consciousness in some altered states).

Resonance condition cannot be satisfied for ME projectors from brain but could be satisfied for ME projectors from the magneto-tail so that one can imagine the possibility of radiative magnetospheric brain circuit connecting these two levels. Note also that cavity resonances inside magnetotail might serve as amplifiers of the cyclotron frequencies in delta band.

What makes the situation interesting is that DNA and presumably also mRNA sequences have a constant charge density [I4] so that the value of the cyclotron frequency does not depend on the length of the sequence. mRNA cyclotron frequency is very near to the cyclotron frequency  $f(O^+) = 2.3$  Hz of  $O^+$  ions at  $r = 2R$  as the following argument shows. The nucleotide pairs in DNA have atomic weights 260 (C-G) and 261 (A-T) and the average weight of the DNA triplet is  $A = 781$ . DNA and presumably also mRNA sequence has constant charge density of 5.88 charges per triplet [I4], which means cyclotron frequency  $f_{mRNA} = 2.26$  Hz in the field of  $B_e = .2$  Tesla. This holds true irrespective of the length of DNA or mRNA. The question is whether a chart about active mRNA sequences might be generated to the  $O^+$  belt and provide kind of a 3-dimensional out-of-body hologram about organism.

#### 5.1.5 A little summary before continuing

For the benefit of the reader it is worthwhile to collect the basic consequences of the proposed model.

1. Inner “endo” -magnetosphere in principle allows representation of frequencies above 8.6 Hz, that is alpha, beta and gamma bands. The EEG spectrum in the range 12.5 – 100 Hz is resonantly representable using protonic cyclotron frequency in the inner magnetosphere, where dipole field approximation is reasonable. The third harmonic of the protonic cyclotron frequency allow to reduce the lower bound for the representable frequencies to 8.6 Hz which is near to the lowest Schumann resonance frequency. Representations come as conjugate pairs corresponding to the representations at the same and opposite side of the globe.
2. Theta and delta bands are representable in the plasma sheet using higher harmonics of cyclotron frequencies and representations are octave wide. This might explain why they are not involved with sensory representations directly conscious-to-us requiring strong intensity in order to be not masked by the sensory input. If non-sensory memories are represented by theta and alpha bands symbolically, this would also explain why memories are usually symbolic rather than concrete re-experiences. Only linear written language like representations by the harmonics of cyclotron frequency make sense inside lobes where the average magnetic field is constant. Symbolic coding could allow to achieve reliability even when the signals are too weak to yield sensory representations not masked by the background noise.
3. Electrons allow the representation of audible frequencies if the higher harmonics of the fundamental frequency of ME are allowed. The representation of audible frequencies at the level of brain using cognitive neutrinos and quantum entanglement is favored. This means also that communications and motor control from the magnetosphere should take place at frequencies which are in EEG range. Kind of high level commands would be in question and perhaps experienced as internal speech.



## 5.2 Do Magnetospheric Structures Correspond Directly To Brain Structures?

p-Adic fractality characterizes the long range correlations of real physics. p-Adic and real space-time sheets are glued together along common rationals, and typically p-adically short scale corresponds to long scale in the real sense and vice versa. Hence the p-adic local physics defined by the p-adic variants of the basic field equations would reduce the p-adic fractality of real physics to mere p-adic smoothness and continuity [K34]. This allows also a more precise view about the origins of p-adic length scale hypothesis.

If one takes seriously the origins of the p-adic fractality, the idea that magnetosphere could contain fractally scaled up representations of structures like brain, does not look so weird anymore. As a matter fact, infinite hierarchy of fractal copies of these structures are expected to be there and provide space-time realization for the universe as a hologram.

Protonic and electronic radiation belts [F13] are optimal candidates for the magnetospheric sensory and motor representations since the densities of protons and electrons are exceptionally high inside belts. The working hypothesis is that from our point of view magnetospheric sensory representations correspond to various kinds of memories (sensory and symbolic memories). Motor representation in turn would correspond to higher level motor control (motor imagination and motor skills).

Inner radiation belt is rather stable unlike the outer radiation belt and there is no night-day variation involved. Inner radiation belt is therefore optimal for the representation of sensory memories whereas outer belt is better suited for the representation of verbal memories using memetic code.

### 5.2.1 What is the magnetospheric counterpart of the left-right asymmetry of brain functioning?

The decomposition of living systems into pairs of almost similar members such that the second member tends to entangle with the external world and the first member remains autonomous and un-entangled system is basic implications of TGD inspired theory of consciousness [K13, K29, K30].

This division of labor seems to occur already at DNA level in the sense that the apparently passive conjugate strand entangles whereas the strand busily expresses itself. At brain level this asymmetry corresponds to the left-right asymmetry. This asymmetry should have a counterpart also at the level of the magnetospheric consciousness and would mean that “right” and “left” magneto-hemispheres are magneto-anatomically different similar but the “right” one is more able to entangle.

Northern and southern lobes are indeed very similar magneto-anatomically and plasma sheet in the equatorial plane separates the northern and southern hemispheres also naturally. Plasma sheet could be a counterpart for the region through which the axonal bundles connecting left and right hemispheres run through: axons are now replaced with magnetic flux tubes. Frontal lobes would correspond to the magneto-pause at the night side and hindbrain would correspond to the day side.

There indeed exists a seed of a functional North-South asymmetry in the sense that the flux tubes of the solar magnetic field are antiparallel (parallel) to the magnetic flux tubes inside the lobe at the northern (southern) magneto-pause. This implies that reconnection process occurs asymmetrically. Since reconnection makes possible entanglement with helio-magnetosphere, this asymmetry might imply that either northern or southern lobe quantum entangles with the helio-magnetosphere with a higher probability.

### 5.2.2 Magnetospheric counterparts of subcortical structures?

The identification of the counterparts for the structures of the middle brain can be based on the requirement that the typical EEG frequencies associated with a given structure are same as the cavity resonance frequencies of the magnetospheric counterpart.

#### 1. *Magnetospheric thalamus*

There are several good reasons for identifying the space-time sheet of Earth’s inner core as the magnetospheric counterpart of thalamus.

1. The characteristic property of thalamus is that it acts a neuronal relay station feeding sensory input to practically all parts of brain and receiving strong feedback. Since the magnetic flux tubes from the inner core of Earth can reach any point of the magnetosphere, the identification of the inner core as the magnetic relay station is uniquely fixed.
2. The space-time sheet of the inner core of Earth corresponds quite closely to 40 Hz cavity resonance frequency in accordance with the requirement that the counterparts of thalamus and primary sensory areas (protonic radiation belt) resonate at this frequency.
3. If the magnetospheric representations above ionosphere correspond to cortical representations, it would seem that the only possible identification for the magnetothalamus is as the inner core of Earth.

Magnetothalamus has even some nuclear structure in the sense that are two pairs of magnetic anomalies (Canada-East Siberia at northern hemisphere and Antarctis-Brazil and southern hemisphere). This suggests that supra currents must have a crucial role in the transfer of information.

### 2. Magnetospheric basal ganglia

Basal ganglia responsible for motor control correspond naturally to frequency of about 14 Hz, which is the basic sensorimotor beta rhythm. The space-time sheet defined by the liquid outer core has this frequency as cavity frequency. Note that the magnetospheric thalamus is topologically condensed at the magnetospheric basal ganglia. Therefore it is perhaps more natural to identify the brain structure in question as that containing thalamus and basal ganglia.

### 3. Magnetospheric pineal gland

Earth's mantle decomposes to two layers such that the sheet associated with the inner sphere has cavity resonance frequency 9.3 Hz. This frequency is the lower bound for the nuclear  $Z^0$  frequency defined by the duration of the memetic code word presumably involved with the symbolic representation of memories. Pineal gland seems to correspond to a frequency  $\sim 10$  Hz defining a biological clock and might correspond to the sphere defined by the inner layer of the mantle.

### 4. Magnetospheric limbic brain

Schumann frequency 7.8 Hz and its harmonics are associated with the space-time sheet of the entire Earth with ionosphere possibly included. Strong resonant input to the tertiary sensory and motor areas should characterize the counterpart of this brain structure. Perhaps a magnetospheric counterpart of hypothalamus, amygdala, and other parts of the limbic brain is in question. This identification is consistent with the fact that Schumann resonance has strong emotional effects.

### 5. Magnetospheric hippocampus

The lowest cavity resonance frequency corresponds to the top of ionosphere ( $r = 2R$ ) is 3.9 Hz. Hippocampus is characterized by the so called hippocampal theta ranging from about 4 Hz up to 12 Hz. Thus it would seem that hippocampus corresponds to the highest structure in the subcortical brain, which by definition contains also the structures below as topologically condensed space-time sheets, so that also higher cavity frequencies are included. A strong input to the association areas should characterize the corresponding brain structure and hippocampus indeed has input to the entire cortex.

## 5.2.3 Magnetospheric counterparts of the sensory areas?

The next task is to identify the magnetospheric counterparts of the primary, secondary, and tertiary sensory areas of the cortex. These areas should correspond to a gradually decreasing frequency scale for resonant representations. The higher odd harmonics of cyclotron frequency indeed have this property (even harmonics couple weakly to cyclotron quantum phase transitions). For proton the two lowest harmonics have range above 8.6 Hz and correspond to the inner magnetosphere (with plasma sheet excluded).

The protonic inner radiation belt could define somatosensory representations of Mother Gaia such that single organism takes the role of neuron. Anatomically the protonic inner belt would correspond primary sensory areas. The primary sensory areas correspond to 40 Hz thalamocortical

sensory representations and correspond to the maximum of protonic flux at at the inner belt. Here also 40 Hz cavity resonance associated with the inner core of Earth and analogous to Schumann resonance might help (note that Earth as conducting solid body exists only at the atomic space-time sheets!). That thalamus is regarded as a generator of 40 Hz resonance frequency conforms with this correspondence.

Secondary sensory and motor areas could define magnetospheric sensory representations covering frequencies down to 8.1 Hz defining the boundary of the night side inner magnetosphere. The decreasing density of protons poses a strong limitation. Schumann resonances could help to increase the intensity at the upper boundary of the protonic belt, where the protonic supra-current is weakest so that also alpha band could be represented. Hippocampal theta is only partially representable: the genuinely theta like part of the hippocampal theta must be represented in the plasma sheet.

Because of the low intensity of supra currents, the representations had better to be symbolic rather than direct images. The coding of EEG features with the duration varying in the interval determined by the range of alpha band by fast and weak amplitude modulation using harmonics of alpha frequency could code these representations. alpha frequency would code for the position and the higher frequencies would assign features associated with the lower level sensory canvases with this point.

Tertiary sensory and motor areas would correspond to magnetospheric sensory representations at the transition region between inner and outer magnetosphere. This region is just plasma sheet at the night side magneto-tail (, which is identifiable as the counterpart of the frontal brain). Plasma sheet defines an octave wide sensory representation for the harmonics of the protonic and electronic  $Z^0$  magnetic frequencies. There are reasons to believe that the self representations in brain reside at the inner surfaces of the left and right brain hemispheres in frontal cortex (insula). This would suggests that plasma sheet which in a well defined sense is between internal and external world (rotating inner and non-rotating outer magnetosphere), is responsible for the magnetospheric self representation. This would also mean that plasma sheet is kind of a primus motor of the magnetosphere. This is consistent with the high level of self-organization (later the discovery about “features” represented in the plasma sheet [F10] will be described).

#### **5.2.4 Plasma sheet and magneto-pause as counterparts of association regions?**

Associations and imagination represent higher level mentality than sensory experience. Sensory associations are generated at the junction OPT of occipital, parietal and temporal lobes whereas frontal lobes could be seen as the seat of highest level mentality like imagination and planning.

Magneto-pause is self-organizing unstable structure and thus ideal for imagination, planning and associations. Occipito-parietal-temporal association regions would be mapped to the day side magneto-pause and frontal association regions to the night side magneto-pause having much higher representative power (the frequency spectrum extends to much lower frequencies). Outer magnetosphere is in a direct contact with this region as are also tertiary sensory areas with various association regions so that the identification is consistent with the continuity requirement.

In the magnetic case day side (shorter cyclotron time scale) perhaps corresponds to sensory imagination whereas night side would correspond to symbolic memories. In the  $Z^0$  magnetic case night side would correspond to motor programs and day side to motor imagination. Communications between magneto-pause and plasma sheet could occur mainly via ME projectors since direct supra currents are not possible unless perhaps during magnetic storms and sub-storms. This is possible since cyclotron frequency scales are essentially same. Note that also entanglement between magneto-pause and plasma sheet making possible the generation of shared and fused mental images is possible. Hence plasma sheet is indeed an ideal candidate for the carrier of self model. Horizontal communications inside magneto-pause are made possible by surface (supra?)currents orthogonal to the discontinuity of the magnetic field.

### **5.3 How Do The Contributions Of Magneto-Tail And Inner Magnetosphere To Our Consciousness Differ?**

The study of the magnetospheric sensory representations leads to considerable insights concerning the differences between sensory, verbal, and motor memories, and imagination. An explanation

for the distinction between sleep and awake emerges, and ageing could be understood as a gradual shift of control from magneto-tail to the inner magnetosphere.

### **5.3.1 The difference between sleep and awake**

Essentially entire EEG above 8.1 Hz is covered by the inner “endo” -magnetosphere. If the inner magnetosphere is responsible for daytime memories, one could understand why we do not possess memories from the period of sleep (we could be still conscious and the identification of plasma sheet as counterpart of self system in brain suggests this!). The dominance of the inner magnetosphere over the outer one should distinguish wake-up state from sleep state and the transition wake-up-to-sleep might be partially controlled by magnetosphere (sleeping spindles). During wake-up the dominance of the inner protonic belt over outer electronic belt would in turn distinguish high sensory alertness from a more inwardly oriented state. Non-autonomous and autonomous parts of the nervous system could correspond roughly to the inner and outer radiation belts. Autonomous system would be mostly unconscious to us because of the low density of protons and thus low rate of the cyclotron quantum phase transitions.

As already proposed, magneto-tail could correspond to frontal lobes and thus motor imagination and planning. This would mean that sleeping periods would involve kind of virtual world training of motor skills, which indeed seems very natural. Learned motor skills represent one type of memory and the magnetospheric electronic representations would have interpretation as this kind of memories. In  $Z^0$  sector magneto-tail would correspond to higher level control of speech and verbal imagination: also speech faculties might be trained during sleep. Plasma tail would be responsible for the highest level of control as the magnetospheric self system.

### **5.3.2 Ageing as a gradual shift of consciousness from magneto-tail to inner magnetosphere**

Delta band gets weaker during ageing and sleeping disorders increase during the old age. Delta band dominates in the EEG of infants and shifts gradually to become eventually alpha band. Thus ageing could be seen as a gradual shift of the consciousness from the outer magnetosphere to the inner magnetosphere. That motor skills and speech develop by trial and error during the first years of life, conforms with the fact that motor consciousness must be highest during this period.

It would seem that ageing means gradual stepping down along the ladder of consciousness and that Buddhist teachings about Karma’s cycle might make sense in quite precise sense. This might be an illusion: the strong delta contribution in the EEG of infant could reflect strong higher level motor control and ageing might mean learning to survive without the advice and control from this level. One could also see life as carving of a 4-dimensional statue and transition to the higher frequencies would mean concentration to increasingly finer temporal details.

The ability to generate new memories gets poorer during ageing whereas childhood memories are rather stable. This is contrary to what neuroscience models for the long term memory tend to predict but in consistency with TGD based mirror mechanism. This difference does not relate to the assumptions of a particular model but to the basic philosophy about time.

Motor and verbal memory representations would be stored to electronic belts whereas sensory memories would reside in the inner protonic belt. Highest level memory representation in a form of self narrative would be stored in the plasma sheet.

In this picture one could understand why we do not have long term memories from the age before 4 years as being due to the absence of ME projectors needed to generate the magnetospheric memory representations. The shift of the control downwards in the magnetosphere could explain why the ability to generate new memories becomes poorer at the older age. During sleep we could enjoy magneto-tail consciousness but would remember what it is to be conscious during sleep only during sleep. Infants could be in this mode of consciousness all the time.

### **5.3.3 Magnetospheric consciousness evolves**

The strength of Earth’s magnetic field has reduced by a factor of order two during the last thousand years whereas Schumann resonances must have remained same all the time. For  $10^3$  years ago the positions of the flux maxima have corresponded to frequencies which are twice the recent frequencies 37.5 Hz, 14 Hz, and 7.8 Hz. The ionic flux intensity at the distance corresponding to

these frequencies has been weaker than today since the distance corresponding to these frequencies is scaled up by a factor 1.26. This might have had dramatic effects on the character of the magnetospheric consciousness and also to that of ours.

If sensory memories are represented protonically in the inner magnetosphere ( $r < 4R$ ), the increase in the intensity of the ionic fluxes involved with the memory representations could correlate with the development of science and the emergence of the high tech civilization. Also the vision of Jaynes [J5] about bicameral man who received commands and advices from collective levels of consciousness and gradually gained long term memory and self model during the last  $10^4$  years could be seen as a self-organization at the level of the magnetosphere, in particular as an evolution of plasma sheet leading to a magnetospheric model of self. This conforms with the fact that the anatomy of brain has not changed during this period appreciably and explains also the huge differences between chimpanzees and humans despite the fact that genomes are almost identical. An interesting question is whether the known temporary lowering of the temperature by several degrees for  $10^4$  years ago correlates with the magnetospheric dynamics and whether it might have initiated an evolutionary process in the magnetosheet with profound consequences.

#### **5.3.4 Plasma sheet, imagination, dreams, and hallucinations**

It would be rather strange if brains would be out of use almost half of the lifetime. Rather, one would expect that the magnetic Mother Gaia uses our brains for information processing purposes during sleep. Imagination and the construction of self model is the most plausible guess for the information processing involved. Dreams could be seen as sensory representations for this imagination.

It has become clear that dreams are cognitive activities involving frontal lobes in an essential manner. A considerable portion of dreams is known to be simulation of the situations encountered during the wake-up state. During daytime the information flow is dominantly from the sensory areas to the frontal lobes but during dreaming the direction is opposite. Brain stem makes dreaming possible but does not dictate the contents of dreams. Translating this to the level of magnetosphere one ends up with the conclusion that dreams and hallucinations are indeed communications from the magnetospheric self to the level of individual self. This view is completely consistent with the general vision of Jaynes [J5] formulated in TGD framework using the notion of semitrance (which is essentially sharing of mental images by quantum entanglement).

As opposed to the relatively high stability of the inner magnetosphere making it suitable for sensory and memory representations, the dynamics of the plasma sheet is rather unstable and self-organizing. This is indeed what imagination requires. The gradual loss of spontaneity and ability to imagine during ageing could in this framework be understood as the gradual shift of the control from outer magnetosphere to the inner one. This would mean also gradual fixation of the self narrative when person “finds herself”: or equivalently ending up to an asymptotic self-organization pattern also at the level of local plasma sheet self-representation. Imagination should not interfere with sensory input and also this condition is satisfied in the plasma sheet.

Moon has also a magnetosphere, and during the period (three days), when the moon is inside the magneto-tail of Earth, the conscious magnetospheres of moon and Earth interact. Perhaps this interaction could provide a justification to the belief that the phase of the moon has strong effects on consciousness of some sensitive persons.

#### **5.3.5 Are the magnetospheric counterparts of brain circuits possible?**

Brain is filled with circuits and there is a heavy feedback from cortex to midbrain and connections between various regions of brain. Also this circuitry should have a magnetospheric counterpart. Magnetic flux tubes define in a natural manner the counterpart of the neural circuitry (magnetic circulation should be present also in brain and represent the deeper quantum control level of neural signalling). Supra- and also ohmic currents running through, say, plasma sheet would provide a representation for their previous history. Even the quantum level counterparts of nerve pulses as solitons propagating along a pair of magnetic flux tubes connected by Josephson junctions realized as flux tubes are possible.

The supra currents emerging at Northern and Southern latitudes from the inner core, which is the magnetospheric counterpart of thalamus, are especially interesting since the flux tubes can

lead anywhere in the magnetosphere. An interesting question is whether the leakage of ions in the polar regions could be somehow analogous to what happens when nerve pulse is transferred from neuron to another one. One can also wonder whether two parallel magnetic flux tubes with join along boundaries bonds/flux tubes between them defining Josephson junctions could carry soliton sequences associated with the phase difference of the super-conducting order parameters. These soliton sequences represent the deeper control signal giving rise to nerve pulse conduction in TGD based model of EEG and nerve [K25] [K25]. If so, then even the quantum counterpart of nerve pulse conduction might make sense at magnetospheric level.

The finding that plasma sheet indeed contains what might be called features [F10], supports the view that this kind of representation mechanism might be involved. Similar findings are predicted at magneto-pause. Supra current circuits would be optimal in this respect. Higher harmonics of proton cyclotron frequency generated by transitions in the plasma sheet and magneto-pause could induce the feedback to the inner magnetosphere and even the resonance condition  $f_m = c/L$  might be satisfied. This mechanism could also allow communications between various areas of the magnetospheric brain. The communication at 40 Hz frequencies between inner core and inner protonic radiation belt would be the magnetospheric analog of thalamocortical resonance.

Fractality inspires some speculations about the general structure of the magnetic circulation. For instance, does thalamus act as the magnetic dipole core of the nervous system? In particular, do the cortical neural loops from thalamus correspond to closed dipole lines at the day side and do the axons to the body define the thalamic counterparts of the magneto-tail? Do all nuclei of brain correspond to magnetic dipoles and does the neural circuitry follow field lines in reasonable approximation?

### 5.3.6 Plasmoids as living magnetic creatures?

Dipole type magnetic field is of course a huge idealization. For instance, plasmoids carry torus like magnetic flux configurations. In TGD Universe these structures could be regarded as higher level electromagnetic life forms. The flux tubes of magnetic field can form extremely complex knotted and linked structures. This topology provides almost enormous representational capacity and one can wonder whether the opportunistic Nature could really have failed to notice this opportunity.

Perhaps the simplest plasmoids (even ball lightning!) might be regarded as the magnetic counterparts of the simplest monocellulars. Note that small plasmoids should be generated also when supra-currents in bio-matter leak out from the magnetic flux tubes. Neural circuits might be accompanied by plasmoids responsible for the self-organization of the ordinary matter around them. Microwaves are effectively the “food” of plasmoids and if magnetic flux tubes carry a magnetic field of order .2 Tesla, the cyclotron transitions of electrons generate microwaves at the upper limit 2.4 GHz for microwaves hearing, so that these plasmoids could generate their “food” themselves. Sun has magnetic field of order .1-1 Tesla in the convective zone and might be ideal place for the plasmoid like life forms of this kind.

Also the dropping of ions from  $k = 151$  space-time sheet to larger space-time sheets generates microwaves (zero point kinetic energy), and this process is probably part of self-organization as suggested by the scaling law of homeopathy and the model of microwave hearing based on the scaling law  $f_h/f_l = c/v = 2^{137-k} \times 2 \times 10^{11}$  giving  $v = 6$  m/s for  $k = 151$  (alpha wave phase velocity at the surface of skull).

In many-sheeted space-time particles topologically condense at all space-time sheets having projection to given region of space-time so that this option makes sense only near the boundaries of space-time sheet of a given system. Also p-adic phase transition increasing the size of the space-time sheet could take place and the liberated energy would correspond to the reduction of zero point kinetic energy. Particles could be transferred from a portion of magnetic flux tube portion to another one with different value of magnetic field and possibly also of Planck constant  $h_{eff}$  so that cyclotron energy would be liberated.

Sun generates plasmoids, especially so during magnetic storms. plasmoids consist of closed magnetic flux tube structures and can be seen as conscious creatures leaving heliomagnetosphere and entering into the interstellar space. Also the plasma sheet of Earth’s magnetosphere generates plasmoids which would become thus magneto-ETs containing as its crew sensory representations about ordinary living organisms at Earth. Perhaps also solar plasmoid like structures could provide living documents about solar magnetospheric history and contain similar sensory representations.

Sharing of the plasmoid mental images by quantum entanglement would make possible for the magnetospheres of Sun and Earth to extend their senses to the entire cosmos.

Also ET experiences might have interpretation as a sharing of mental images induced by encounters with the plasmoids generated during the tectonic activity. The visible pseudo UFO itself could be the plasmoid generated by the leakage of supra currents from magnetic flux tubes, when the flux tubes in the stream of magnetic flux from the spot of the tectonic activity reconnect with the flux tubes of the personal sensory magnetic canvas or with those of Earth's magnetic field. Also genuine UFOs might be plasmoid structures emitted from the plasma sheet of some planet of a distant stellar system which have managed to penetrate through the cusp region of the magnetopause of Earth, which serves as a magneto-immune system preventing the penetration of solar and other interplanetary magnetic life forms inside magnetosphere!

The somewhat ghostly crew of a magneto-UFO could consist of magnetospheric sensory representations for the inhabitants of this planet but this would not diminish the reality of the experience. Space travel of mental images would not require transfer of huge amounts of fuel through cosmos and light velocity would not be a limitation for the communications. There are good reasons to believe that higher levels of the self hierarchy have discovered mental space travel long ago if even we have been able to invent it!

There is however evidence for "metallic" UFOs too. TGD based model [K36] for the strange antigravity like effects observed in rotating magnetic systems [H6] leads to a mechanism which might be behind flying saucers. The basic idea is that the space-time sheet of rotating magnet is connected to the space-time sheet carrying Earth's gravitational field by join along boundaries bonds/flux tubes, one can visualize them as threads connecting the rotating system to the environment. Along these threads the gravitational flux created by the magnet flows to Earth's space-time sheet and these threads mediate the gravitational interaction.

Rotation causes the entanglement of the threads and when the rotational speed becomes high enough, the threads begin to split. This means that the ends of the split threads become carriers of negative and positive gravitational mass. Effectively the gravitational mass of the magnet system remains to the Earth's space-time sheet and the mass of magnet system itself decreases and angular momentum conservation implies an acceleration of the spinning motion (pirouette effect). If the inertial mass is equal to the gravitational mass as Equivalence Principle requires, one gets a system which is light as a feather!

One can wonder whether this could provide a mechanism making possible flying saucers. For instance, the rotating system could liberate some of its chemical energy to generate a very fast motion. It could also accelerate and change direction of motion very quickly. The strange properties of UFOs suggest that if they are really flying saucers, a reduction of the inertial mass is indeed involved. Thus one might think of the possibility that plasmoid like structure and a more rigid structure accompany each other in some cases. The rotating magnet system involves also plasma near its outer boundary and would in this case be due to acceleration of ions in radial electric field generate by the rotating magnet. Plasmoid like structures indeed involve magnetic flux tubes and this suggests that they could rotate rapidly and in this manner reduce their gravitational mass.

What about abduction experiences? Could they be mere quantum telepathy or do they represent real encounters with plasmoid like life forms? And what about the claimed Roswell case involving a "traffic accident" of UFO and dead bodies of aliens? The TGD based model for crop formations [K8, K9] suggests that parallel space-time sheet do not only carry supra currents but could be inhabited! Plasmoid like life forms would be much like ordinary life forms with DNA and proteins at magnetic flux tubes. The Chilbolton and Crabwood crop circles allow to even deduce rather precise information about the genetic codes of these life forms, and the second genetic code involves 80 DNAs and 23 amino-acids. This would mean that the civilization in question might be at a much higher evolutionary level that we are, and could have developed antigravity technology for long time ago. This forces to consider the possibility that abduction experiences are real interactions between life forms living at different space-time sheets.

### 5.3.7 Plasmoids in laboratory

It seems that one of the most craziest predictions of TGD inspired theory of consciousness has been realized at laboratory. Quite recent report tells about plasmoids generated in a simple diode involving plasma generator creating plasma column between itself and the positively charged anode

[17]. The plasmoids are self-organizing structures able to evolve in a period of few microseconds. They possess many properties that life forms are expected to have. Plasmoids

1. grow from micrometer size up to cm size,
2. replicate by simply dividing into two pieces,
3. have an outer negatively charged surface separating the positively charged interior from the environment and obviously analogous to the cell membrane. Hence the plasmoid is analogous to a capacitor, and the exchange of matter with the environment could correspond to a dielectric breakdown essential for qualia in TGD based model of the sensory receptor,
4. possess a metabolic cycle involving the transfer of matter between the interior of the plasmoid and environment. This cycle is seen as a periodic generation of visible light at specific frequencies: the light balls are typically found to be red or yellow. The frequency of metabolic oscillations is at 25-45 kHz frequency range,
5. are able to communicate by generating electromagnetic radiation by inducing vibrations in the receiving plasmoid at the same frequency.

These findings give valuable hints concerning the more detailed modelling the “biology” of plasmoids. Plasmoids are in a key role in the TGD inspired model of pre-biotic evolution discussed in [?]. For instance, one can ask whether the preferred colors might be interpreted in terms of quantized increments of zero point kinetic energies liberated when atoms or ions (such as C, N, and O) drop from the hot  $k = 131$  space-time sheets (temperature being of the order of the zero point kinetic energy) to larger space-time sheets.

## 5.4 Some Applications

Also applications provide tests for a theory and below some tests for the notion of magnetospheric consciousness are discussed.

### 5.4.1 Space traveller consciousness

The understanding of the basic facts about EEG on basis of resonance condition suggests that magnetospheric representations are there. The resonant magnetospheric representations cannot however be the whole story since this would mean spectacular effects on the sensory consciousness of space travellers. Long distance space travelling might be even impossible without dramatic effects for consciousness. The distance to the moon corresponds to  $d \sim 60R$  and in the interstellar space moon travellers should have experienced these effects. The fact that moon and space travellers have survived (although some of them have reported strange experiences and Edgar Mitchell has even founded Noetic Institute for the study of consciousness!) forces to consider the notion of resonance very critically.

The most realistic assumption is that our sensory representations are realized on personal magnetic bodies rather than that of Earth. This magnetic body would follow the space traveller. The representations at the magnetic sensory canvas defined by Earth’s magnetic field are there but contribute mainly to the consciousness of the magnetic Mother Gaia and other higher level selves. These representations contribute also to our consciousness via the sharing of the mental images. The fact that  $B_{end} = 2B_E/5$  corresponds to the magnetic field strength explaining the effects of ELF em fields on matter supports this hypothesis.

Obviously, the study of consciousness of space travellers should provide valuable information about the importance of the magnetospheric contribution to the consciousness.

### 5.4.2 NDEs and OBEs

The distinction between out-of-body experiences and ordinary sensory experiences is a challenge for any model of sensory representations. Out-of-body experiences are associated with NDE experiences during which sensory input is absent and standard neuroscience suggest that brains do not contribute to the conscious experience. The characteristic aspect of out-of-body experience is third person aspect. This supports the naïve conclusion that personal sensory magnetic canvas is



not responsible for OBES but that third person perspective involves entanglement with the mental image of the magnetic Mother Gaia about us. We would share the mental image of Mother Gaia about us. Even in the case that our personal sensory magnetic canvas ceases to exist, the magnetospheric representations would continue to exist. Also the deceased relatives encountered during NDEs could be magnetospheric mental images about them.

An interesting little sidetrack is perhaps allowed here. Stopping of breathing is the crucial step in the process leading to the physical death. The magnetic particles in lungs generate magnetic field with strength of order 10 nT: a magnetic field of same strength prevails also in plasma sheet and night side magneto-pause so that magnetic mirror communications at protonic cyclotron harmonics are possible between lungs and plasma sheet. The rhythm of breathing is in delta range which belongs to the range of frequencies representable in magneto-tail. Could it be that there are direct ME projections from plasma sheet to lungs at delta band and that the control of breathing involves these MEs and that the command leading to the physical death is sent from plasma sheet? Could it be that the “primitive” association of soul with breathing might carry some deep truth in it?

### 5.4.3 Relating the model to personal experiences

My personal altered states of consciousness have been a continual source of inspiration and challenge during the development of TGD inspired theory of consciousness. In the following I propose a model for the flow experience, which I have practically always when I close my eyes.

#### 1. *The experience*

Especially inspiring has been the visual experience about complex background flow which becomes visible when eyes are closed. This experience does not seem to correlate with the sensory input although in light illumination the flow is brightly colored and the color varies in an unpredictable-by-me manner. The flow is most intense when I am in a calm state of mind and especially strong under creative periods of theory building. The flow contains in its “unexcited” state a “third eye” component, kind of a tunnel, to which the flow seems to converge. This sink can temporarily transform to a source. The disk like sink can also transform to a slit like sink. In a more aroused mental state the flow becomes very complex containing sources and sinks. The flow becomes also rotational: in particular, the flow whirls to the sink or from the source as a vortex.

I experience the background flow also at night time and there seems to be no sharp night-day difference. During night time immediately after wake-up I can also see very clear and beautiful organized abstract geometric patterns (like lattices) which vary very slowly. During my “great experience” the flow served as a background for vivid hallucinations. The hallucinatory contributions were superposed to the ordinary sensory input and these contributions were more or less independent from each other.

The complex, unstable background flow carries high resemblance to an incompressible hydrodynamic flow. Also magnetic field satisfies condition analogous to the incompressibility condition for the hydrodynamic flow ( $\nabla \cdot B = 0$ ). Hence the question has been whether this flow actually represents hydrodynamical flow, endogenous or exogenous magnetic field and supra current flow along its flux tubes, or whether it is a representation for a background neuronal activity which is usually not so strong.

#### 2. *The explanation*

The most plausible interpretation for the experience is based on the observation that the background flow is best visible when eyes are lightly closed. This means that there is probably some amount of 40 Hz activity without definite sensory input and that alpha band dominates.

1. The flow represents alpha signal from the sensory canvas to brain mediated by Schumann resonances and is so weak because 40 Hz resonance is weak with closed eyes. The signal is masked by visual input when eyes are open. This mechanism explains also dreams and hallucinations as communications from various levels of magnetosphere via brain to the inner radiation belt and conforms with the semitrance model of bicameral consciousness.
2. The flow represents electronic supra-current flow running parallel to the magnetic flux tubes of the outer radiation belt. This flow could in turn represent the magnetic state of brain or body. The “third eye” contribution could represent the supra currents converging to the

spinal cord. Or the vision could represent cortical magnetic flux tube structure converging to the thalamus serving as the basic dipole core of the brain's magnetic field. Higher level selves might in fact represent it more or less automatically.

3. The presence of the hallucinatory component during great experience could be interpreted as additional communication from the magnetic sensory canvas via brain to the inner radiation belt. The simultaneous presence of both 40 Hz and alpha band vision would differentiate this period of a very intense brain activity from the experiences in which only alpha or gamma vision is present.
4. Also hypnagogic experiences which are sometimes transpersonal (I experience of being genuinely someone else) occur when alpha band dominates. This encourages to think that the amplification mechanism is based on Schumann resonance made possible by unusually strong coupling between magnetosphere and personal magnetic canvas: this coupling would become strong during creative periods. The correlation of the alpha band dominance with creativity is standard folk wisdom at least. Also this supports the view that communication from the outer radiation belt to brain and from brain to the first radiation belt is involved.

Besides the lowest 7.8 Schumann resonance also the second 14 Hz sleeping spindle Schumann resonance might be involved: I am often told that I have been sleeping when I have been sitting and thinking for a long time (I disagree strongly!). 14 Hz sleeping spindle Schumann resonance corresponds to  $n = 3$  protonic cyclotron resonance and the electronic spin flip resonance at the electronic flux maximum  $r = 4R$  in the outer radiation belt.

5. The night time vision about highly symmetric slowly varying lattice like structures might in turn correspond to a situation in which the self-organization pattern in plasma sheet is projected to brain in theta or delta band and from brain to the first radiation belt. Also now the lattice like patterns in plasma sheet might represent the state of brain or body.

## Appendix

### 1. Schumann resonances

Schumann resonances [F8] represent resonant excitations of the Earth's electromagnetic field in the cavity defined by the spherical cell bounded by the Earth's surface and the lower edge of the ionosphere located at the height of roughly 100 km. The lowest Schumann resonance frequencies have nominal values 7.8, 14, 20, 26, 33, 39, 45 Hz with a temporal variation of  $\pm 0.5$  Hz.

It is often said that Schumann resonance frequencies characterize the cavity modes associated with the  $d \sim 100$  km thick spherical shell below ionosphere acting effectively as a waveguide bounded by Earth and ionosphere acting as conductors. This is not the case since the cutoff frequency for this waveguide would be in a good approximation  $f = c/d$  which is about  $f = 3$  kHz and much higher than Schumann resonance frequencies. The only manner to understand Schumann resonance frequencies is to assume that boundary conditions analogous to those used for half-open system, such as organ pipe. This amounts to requiring that the field modes vanish at the surface of Earth or the lower edge of the ionosphere but not both. Schumann resonances would be selected by a boundary condition stating essentially that the energy does not leak out from the system at the upper edge of the ionosphere.

It seems that the web contains a lot of confusion related to the Schumann resonances and the motivation to write my own view came with the realization that also my own understanding about Schumann resonance was rather misty. My sincere hope is that my unprofessional, TGD inspired ponderings do not increase the already existing confusion. The article "Schumann resonances and human psychobiology" by Richard and Iona Miller [J7] is recommended for a reader who wants to gain an overall view about various aspects of the phenomenon.

#### 1.1 Schumann frequency spectrum

Consider now the calculation of Schumann frequency spectrum by taking into account the finite thickness of the Schumann cavity neglecting the complications caused by spin of photon. For scalar

wave equation the wave equation in radial variable for solution proportional to spherical harmonic  $Y_m^l$  reads as

$$\left[ -\partial_r^2 - \frac{2}{r}\partial_r + \frac{l(l+1)}{r^2} \right] F_l = \omega^2 F_l . \quad (5.1)$$

By writing  $F_l = G_l/r$  this equation can be cast into the form

$$\left[ -\partial_r^2 + \frac{l(l+1)}{r^2} \right] G_l = \omega^2 G_l . \quad (5.2)$$

The term proportional to angular momentum term varies very little in the thin Schumann cavity. Therefore it is reasonable to separate the constant part from the small variation by writing the equation in the form

$$\begin{aligned} \left[ -\partial_r^2 + l(l+1)\left(\frac{1}{r^2} - \frac{1}{R^2}\right) \right] G_l &= E G_l , \\ \omega^2 &= E + \frac{l(l+1)}{R^2} . \end{aligned} \quad (5.3)$$

Here  $E$ , playing the role of energy in the analog with Schrödinger equation, can be also negative implying that omega is below the alpha peak frequency for  $l = 1$ .

The Schumann frequency spectrum should be continuous since the only sensible boundary conditions correspond to organ pipe type boundary conditions requiring that the  $G$  vanishes at the surface of Earth (or, less probably at the lower edge of the ionosphere).

One can use the analogy with one-dimensional Schrödinger equation for particle with mass  $2m = 1$  ( $\hbar = 1$ ) and energy  $E$  at half-line  $r > R$  in order to understand the spectrum. The angular momentum term defines the potential function as

$$\begin{aligned} V(r) &= l(l+1) \left[ \frac{1}{r^2} - \frac{1}{R^2} \right] , \\ V(r) &= \infty \text{ for } r \leq R \end{aligned} \quad (5.4)$$

The potential function vanishes at origin origin and approaches to  $V(\infty) = -l(l+1)\frac{1}{R^2}$  at infinity. There are no classical bound state solutions since the force  $f(r) = -\partial_r V = 2l(l+1)/r^3$  drives the particle to infinity.

The spectrum satisfies the condition

$$\begin{aligned} E &\geq V(\infty) = -l(l+1)\frac{1}{R^2} , \\ \omega^2 &\geq 0 . \end{aligned} \quad (5.5)$$

In accordance with the expectation that the spectrum of Schumann frequencies is continuous.

## 1.2 The identification of Schumann resonance frequencies

In order to identify the Schumann resonances from the continuum one should apply some natural boundary condition. The vanishing of  $G$  at  $r = R + d$  is certainly not a natural condition. Schrödinger equation however suggests an analogy. The radial probability current is proportional to  $\partial_r G_l$ . In resonance this current should vanish at  $r = R + d$  so that one would have

$$\partial_r G(r)_{r=R+d} = 0 . \quad (5.6)$$

This condition determines the possible values of  $f$  for resonances. When  $d$  varies, also Schumann resonance frequencies vary. That the lowest Schumann frequency should be  $f_c = 1/(2\pi R) = 7.5$  Hz in a good approximation can be understood from the idea that in resonance ELF light rays move along geodesics of the sphere having length  $\lambda = 2\pi R$  defining the frequency as  $f_c = c/\lambda$ . This would suggest that at least the lowest Schumann resonance frequency does not appreciably depend on the thickness of the Schumann cavity.

### 1.3 Dimensional reduction of Schumann cavity to a sphere and alpha peak frequency

In the case radially very slowly varying modes dimensional reduction of the thin Schumann cavity to sphere occurs and wave equation reduces to that on sphere with radius  $R$  and the solutions are spherical harmonics. This allows to immediately write the frequency spectrum as

$$\begin{aligned} f_l &= \sqrt{l(l+1)}f_c , \\ f_c &= \frac{c}{2\pi R} . \end{aligned} \quad (5.7)$$

where  $f_c = 7.5$  Hz is the lowest Schumann resonance frequency and  $l = 1, 2, 3, \dots$ , characterizes the angular momentum quantum number of the spherical harmonic.

The following observations are rather interesting as regards to the interaction between magnetosphere and brain.

1. The lowest frequency of this kind corresponding to  $l = 1$  is  $f_1 = 10.6$  Hz. This is the peak alpha frequency and essentially the frequency of the memetic code! Note that this frequency does not depend on the thickness of the Schumann cavity at all. The lowest Schumann resonance frequency  $f_c \simeq 1/2\pi R \simeq 7.5$  Hz is by a factor  $\sqrt{2}$  lower than the peak frequency of alpha band.
2. The higher frequencies are  $f_2 = 18.4$  Hz,  $f_3 = 26.0$  Hz,  $f_4 = 33.5$  Hz,  $f_5 = 41.1$  Hz. The appearance of 26 Hz and 41 Hz, which are resonance frequencies of EEG, suggests a connection between alpha wave band and Schumann frequencies for almost radially constant modes. The comparison with the spectrum the spectrum 7.5, 14, 20, 26, 33, 39 Hz of Schumann frequencies shows that the two frequency spectra resemble each other.

alpha wave peak and possibly also higher peak frequencies of EEG spectrum could correspond to zero modes, which are very slowly varying with respect to the radial coordinate.

3. The cutoff frequency for genuine Schumann cavity solutions is  $f = c/d$  and for  $d = 100$  km one has  $f = 3$  kHz (note however that the values for  $d$  vary from 80 – 100 km. The time for the light ray to move forth and back in radial direction is .67 ms and only slightly shorter than the duration  $\tau = .78$  for the bit of the memetic codon. If the corresponding ME is parallel to curvilinear magnetic flux tube turning back at the lower edge of the ionosphere, the time is longer. This could easily explain the discrepancy.

### 1.4 Coupling of the magnetospheric cavity modes with Schumann cavity frequencies

One can also consider the field modes associated with the space-time sheet representing a ball of radius  $R_1$  vanishing at the boundary. The solutions of the radial wave equation for  $F_l$  already written explicitly can be constructed in terms of spherical Bessel functions for which one can derive explicit expressions in terms of elementary functions. The lowest  $l = 0$  mode regular at origin is

$$F_0(r) = \frac{\sin(u)}{u} .$$

1. The vanishing of  $F_0(r)$  at the surface of Earth gives  $f_0 = c/R = 2\pi f_s$  giving  $f_0 = 47.2$  Hz. The lowest Schumann resonance frequency of the core-inner core boundary is around this value assuming that geometric argument holds true, and one can consider the possibility that a communication analogous based on the coupling between these modes is occurring.
2. It is also interesting to look for the cavity modes for the inner magnetosphere. The boundary of the inner magnetosphere is located in the interval  $[4R, 6R]$  which corresponds to the range  $[7.86, 11.8]$  Hz for  $f_0$  covering alpha band. For the lowest zeros of  $f_1$  and  $f_2$  the corresponding ranges are  $[22.5, 33.7]$  Hz and  $[28.8, 43.3]$  Hz. This suggests that discrete frequencies in alpha band and also higher EEG bands in Schumann cavity couple to the cavity modes associated with the space-time sheet of the inner magnetosphere. The erratic identification of this frequency as Schumann resonance frequency is possible. Also cyclotron frequency of proton at  $r \simeq 4R$  crucial for magnetospheric sensory representations is in alpha band.

This would imply a direct coupling between solar wind and brain: the solar wind would affect the size of the inner magnetosphere, in turn affecting the over all scale of the corresponding cavity frequency band in turn affecting the alpha band in Schumann cavity in turn affecting brain. Strong solar wind would compress the magnetosphere and tend to the discrete frequency in the alpha band. This could explain the negative effects of the solar wind on the mood of sensitive persons.

### 1.5 Variation of the Schumann frequency with time

The measured lowest Schumann resonance frequency varies with time. There is a variation of  $\pm 5$  Hz but also claims about variation up to 11 Hz. The argument allowing to understand geometrically the lowest resonance frequency suggests that the varying thickness of the Schumann cavity does not affect the lowest Schumann resonance frequency. One can imagine several explanations for the claimed wandering.

1. Due to the coupling of the Schumann cavity modes to the modes associated with the space-time sheet of the inner magnetosphere (with radius varying in the range  $[4R, 6R]$ ) to be discussed below in detail, the wandering frequency identified as the lowest Schumann resonance frequency could actually be the cavity frequency of the inner magnetosphere. In this case quite wide variation range is possible.
2. The second option is that the boundary conditions stating the vanishing of field components fail to be satisfied at the surface of Earth. Physically this would mean the generation of an oscillating surface current and a surface charge density defined by the tangential discontinuities of magnetic and electric fields of the resonance modes. The simplest possibility is that there is a surface current parallel near to the surface of Earth with the rotational motion of Earth, which generates magnetic field discontinuity in the direction of longitudes and the discontinuity of electric field in the radial direction. This current would be oscillatory and might perhaps be seen as a parallel mirror image of the ionic current at the lower edge of the ionosphere of Earth: this real mirror current would cause Earth to effectively act like a conductor.

The lower edge of the Earth's crust at depth of 30-60 km is roughly a almost mirror image for the lower edge of the ionosphere and could be the seat of the mirror current. In the ideal situation the contributions of the two currents to the oscillating magnetic field at the surface of Earth would be of opposite sign and cancel but the variation for the height of the lower edge of the ionosphere would imply asymmetry, and the breaking of the standard boundary condition at the surface of Earth in turn changing the Schumann frequency.

## 2. Alfven waves, magnetic flux tubes, cosmic strings, and hadronic strings

In TGD framework Alfven waves correspond to the geometric oscillations of the magnetic flux tubes. The understanding of these oscillations represents a horrible mathematical problem and it is not even obvious that effectively massless modes are possible. It is however possible to understand magnetic flux tubes as a member of an extremely general family of solutions containing as special cases cosmic strings, hadronic strings and magnetic flux tubes. That Alfven waves would be mathematically very similar to the excitations of strings gives a glimpse about the mathematical beauties of the actual physics lurking behind such a simple looking thing as Earth's magnetic field.

One can in principle construct magnetic flux tube like solutions as deformations of cosmic string solution  $X^2 \times D^2$ , where  $X^2$  is any minimal surface and  $D^2$  is piece of the geodesic sphere  $S^2$  of  $CP_2$ . By allowing the  $M^4$  coordinates transversal to  $X^2$  to depend on  $D^2$  coordinates so that one has field theory in  $X^2 \times S^2$  with the transversal  $M^4$  coordinates taking the role of fields. A static flux tube is obtained when  $X^2$  is a piece of two-dimensional hyperplane  $M^2 \subset M^4$ . Thus an infinitely thin string representing projection to  $M^4$  spreads to a magnetic flux tube. The general stringy solutions  $X^2 \times D^2$  describe excitations travelling with light velocity along string. If the deformation inherits this property, one can say that the oscillations of the flux tube propagate with light velocity and  $f = c/L$  dispersion relation holds true apart from effects caused by the deviation of the induced metric from a flat metric.

Thanks to the progress in the understanding of the spectrum of the extremals of the Kähler action it is now possible to construct rather explicitly the deformations of “cosmic strings” to magnetic flux tubes. The construction demonstrates that the massless transverse modes of string indeed become Alfven waves [K4, K20].

## 6 Could brain be represented as a hyperbolic geometry?

There are proposals that neuronal systems in brain could have hyperbolic geometry [J3] (<http://tinyurl.com/ybghux6d>) in the sense that neurons could be mappable to a 2-D lattice like structure representable in terms of to 2-D hyperbolic geometry  $H^2$ . A concrete identification as a lattice-like structure in  $H^2$  would not be in question.

### 6.1 A concrete representation of hyperbolic geometry cannot be in question

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

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

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

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

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

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

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

### 6.2 Hyperbolic geometry and its tessellations

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

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

The group  $SL(X)$ ,  $X = C, R$ , consists of matrices  $[a, b; c, d]$  with  $a, b, c, d \in X$  satisfying  $ad - bc = 1$ . The modular group  $SL(2, Z)$  acts subgroup of both  $SL(2, C)$  and  $SL(2, R)$ .  $SL(2, C)$  resp.  $SL(2, R)$  forms a double covering of Lorentz group  $SO(1, 3)$  resp.  $SO(1, 2) = SL(2, R)$ .  $SL(2, C)/SU(2) = SO(1, 3)/SO(3)$  defines 3-D hyperbolic geometry  $H^3$  realized as  $a = \sqrt{t^2 - x^2 - y^2 - z^2} =$  constant hyperboloid of future light-cone  $M_+^4$  having  $SO(1, 3)$  as isometries.  $SL(2, R) = SO(1, 2)$  acts as isometries of  $H^2$  realizes as hyperboloid of  $M_+^3$ .  $SL(2, C)$  resp.  $SL(2, R)$  acts as complex resp. real Möbius (conformal) transformations  $z \rightarrow (az + b)/(cz + d)$ ,  $ad - bc = 1$ , of complex plane resp. upper half plane.

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

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

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

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

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

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

### 6.3 Could magnetic body provide a concrete geometric representation for the tessellation of hyperbolic space?

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

The question is whether one could generalize the hypothesis [J3] (<http://tinyurl.com/ybghux6d>) in TGD framework. In the sequel such a generalization replacing 2-D hyperbolic space with its 3-D counterpart and assuming that the hyperbolic tessellation is associated with MB of brain or of its subsystem considered. This generalization reduces to  $P^2$  if one restricts  $P^3$  to subspace  $P^2$  and restricts  $SL(2, C)$  ( $SO(1, 3)$ ) as symmetry to cylindrical symmetry  $SL(2, R)$  ( $SO(1, 2)$ ). Cylindrical symmetry is natural to magnetic flux tubes and cylindrical magnetic flux sheets so that  $P^2$  option might be more natural.

The notion of MB is extremely general and makes sense in all scales, and one can consider the possibility that the hyperbolic tessellations could provide a kind of universal for the MB of system responsible for cognitive representations.

## 6.4 Could regions of brain be mapped to tessellations of 3-D hyperbolic space defined by magnetic body?

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

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

1. either to a tessellation of  $H^3$  at which  $SL(2, C)$  acts as isometries,
2. or to a cylindrically to a tessellation of  $H^2$  at which  $SL(2, R)$  acts as isometries represented as upper half-plane or as Poincare disk where the action is as conformal transformation. One can consider also mapping to a complex plane compactified to Riemann sphere at which  $SL(2, C)$  acts: now the action is however not as isometries but conformal transformations.

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

### 6.4.1 Some basic facts

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

1. 3-D hyperbolic space  $H^3$  representable as hyperboloid  $t^2 - x^2 - y^2 - z^2 \equiv t^2 - r_M^2 = a^2$ .  $a$  has interpretation as light-cone proper time and in TGD inspired cosmology it corresponds to cosmic time. 2-D hyperbolic space could be seen as subspace of  $H^3$ . Now infinite discrete subgroups of  $SO(1, 3)$  would define tessellations as lattice-like structures. They would serve as 3-D analogs of Platonic solids. I have proposed [K17] that they could explain the astrophysical objects a located along lines with redshifts coming as multiples of a basic redshift in terms of lattice-like structures in cosmic scales.
2. Brain region itself cannot correspond in any manner to a region of  $H^3$  represented as  $a = constant = a_0$  hyperboloid. MB of brain region might however do so. The mapping of brain region to the hyperboloid  $a = a_0$  could be mediated by gravitational magnetic flux tubes which can be radial since the Kähler flux vanishes in good approximation and there is no conserved monopole flux. Only the cognitive representation as discrete points in extension of rationals would correspond to points of the hyperboloid.

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

3. One can challenge the assumption about cosmic expansion of MB. Quite generally, all known astrophysical objects participate in cosmological expansion by receding from each other as the cosmic redshifts show but do not experience cosmological expansion themselves. TGD solves this paradox by the assumption that cosmic expansion takes place as quantum phase transitions in which expansion occurs in rapid jerks, which correspond to reductions of length scale dependent cosmological constant  $\Lambda$  by a power of 2 if p-adic length scale hypothesis is accepted [?] .

There is evidence that even Earth has experienced this kind of expansion during Cambrian Explosion, which would have increased the radius of Earth by factor 2 [?]. This would have



been also a giant step in biological evolution as the multicellular life developed in the Earth's interior would have bursted to the surface of Earth and oceans would have formed. An interesting question inspired by the fractality of TGD Universe is whether one could see also the biological growth and development of organs and organelles as sequences of this kind of phase transitions.

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

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

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

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

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

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

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

having an interpretation as velocity  $\beta = v/c$  in radial direction satisfying  $\beta \leq 1$ : one has  $t = a \cosh(\eta)$  and  $r_M = a \sinh(\eta)$ .

#### 6.4.2 About the precise correspondence between 3-D surfaces and $H^3$

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

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

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

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

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

3. A tessellation of  $H^3$  corresponds to the points  $\{(a \sinh(\eta_n), \Omega_n)\}$ . The lattice-like structure in  $E^3$  for  $t = T$  would correspond to points  $(r_M, \Omega)$  in  $\{T \tanh(\eta_n), \Omega_n\}$ . The difference from the representation hyperbolic geometry as  $H^3$  is that instead of  $r_M = a \sinh(\theta_n)$  for  $H^3$

one has  $r_M = T \tanh(\eta_n)$  for the analog of Poincare disk. For small values of  $\eta$  one has  $\sinh(\eta) \simeq \tanh(\eta)$  but not for large values so that  $E^3$  is compressed to Poincare ball  $B^3$ .

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

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

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

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

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

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

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

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

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

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

This picture suggests an interesting connection to TGD based view about quantum measurement theory [?], which actually extends physics to a theory of consciousness. Causal diamonds (CDs) have a key role in ZEO and hyperbolic geometry is very naturally associated with them. The notions  $M^8 - H$  duality [?, ?] could provide an explanation for the special value  $t = T$ , and tessellations could correspond to a particular cognitive representation [?].

1. In zero energy ontology (ZEO) replacing ordinary ontology of quantum theory the notion of causal diamond (CD) plays a central role. CDs for a length scale hierarchy and CDs have sub-CDs. Space-time surfaces for given CD have ends at the upper and lower boundary of CD. In this picture the appearance of hyperbolic geometry at the level of MB would be very natural.
2.  $M^8 - H$  duality [?] states that space-time surfaces could be regarded either as algebraic surfaces in  $M^8$  or as preferred extremals of action in  $H = M^4 \times CP_2$  reducing to minimal surface satisfying infinite number of additional conditions. Otherwise the consistency of dynamics in  $H$  dictated by partial differential equations with algebraic dynamics in  $M^8$  dictated by algebraic equations would not be possible.

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

3. A special prediction of  $M^8$  picture is that besides 4-D surfaces as roots of algebraic equations also 6-D special brane-like solutions with topology of 6-sphere  $S^6$  are possible. For these solutions both real and imaginary parts vanish. These solutions have counterparts in  $H$ , and their intersection with cd is  $t = r_n$  ball, where  $r_n$  is the root of  $P$ .
4. I have called the moments  $t = r_n$  “very special moments in the life of self” identified as evolution of zero energy state of self by “small” state function reductions (SSFRs) as analogs of weak measurements. Also the size of CD increases in this process in statistical sense and corresponds to the increase of clock time as a natural correlate of subjective time defined by the sequence of SSFRs.
5. Could the state of neuron system at  $t = T$  correspond to  $T = r_n$  as a root of polynomial  $P$ ? Could these special moments correspond to rapid jerks in the cosmological expansion so that also the development of living organism would involve a sequence of them increasing the value of  $\Lambda$ . Presumably these jerks would occur at the level of MB and possibly induce those at the level of biological body. At the level of MB they could also correspond to a phase transition like events in the evolution of consciousness involving scaling up the size of MB.

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

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

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

### 6.5.1 Salamander recovers after shuffling of its brain

In the lab, the neurons of the brain of a salamander were shuffled like a pack of cards. The salamander however recovered and preserved its memories (identified as learned behaviors) [J9]. In [K22, K23] this finding was considered as a support for the view that the brain is analogous to a hologram (TGD Universe can be seen as a conscious hologram [K5]). It seems, however, clear that a single neuron cannot represent the information content of the entire brain. However, if memories are represented by the images of neurons at the level of the MB, the shuffling of neurons has no effect on memories as the experiment indeed demonstrated. Neurons would be analogous to RAM in computer science.

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

The popular article "Polycarpa mytiligera can regrow all of its organs if dissected into three pieces" <https://cutt.ly/SndWg81> tells about an extraordinary biological discovery.

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

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

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

1. In TGD inspired quantum biology magnetic body (MB) carrying dark matter as  $h_{eff}/h_0 = n$  phases is the key notion.  $h_{eff}$  is an effective Planck constant defining the scale of quantum coherence.  $n$  is dimension of extension of rationals defined by a polynomial defining space-time region, and serves as a measure for algebraic complexity and serves as a kind of IQ. MB with high IQ defined by  $n$  serves as the master of BB controlling it and receiving information from it. The layers of MB also define abstracted representations of BB.
2. If BB suffers damage, the information about BB is not lost at MB and MB, which carries abstracted representations about BB and able to control BB, could restore BB partially. Healing of wounds would be the basic example. A more dramatic example about healing was discovered by Peoch: the neurons of the salamander brain can be shuffled like cards in a package but the animal recovers.

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

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

1. In the TGD framework, quantum measurement theory relies on zero energy ontology (ZEO) and solves its basic problem. The basic prediction is that in the TGD counterparts of ordinary state function reductions ("big" SFRs or BSFRs) time reversal takes place. In small SFRs (SSFRs) identifiable as analogs of "weak" measurements, the arrow of time is preserved. ZEO makes it also possible to understand why the Universe looks classical in all scales although BSFRs occur in all scales at the dark onion-like layers of MB controlling the lower layers with ordinary biomatter at the bottom of the hierarchy.
2. Time reversed dissipation after BSFR looks like self-organization from the perspective of the outsider with a standard arrow of time, called it briefly O, and would be a basic self-organization process in living systems. In dissipation gradients disappear but in time-reversed dissipation they appear from the perspective of O.
3. This makes possible also self-organized quantum criticality (SOQC), which is impossible in standard thermodynamics because criticality by definition means instability. The change of the arrow of time changes the situation from the perspective of O since the time reversed system tends to approach the criticality. Homeostasis would rely SOQC rather than on extremely complex deterministic control programs as in the computerism based picture. Change the arrow of time for a subsystem and let it happen. Very Buddhist approach to healing!
4. The change of the arrow of time would be also central in the healing processes and also regeneration.

## 7 DMT experiences and hyperbolic geometry

I received a link to a highly inspiring talk about a modelling of DMT induced experiences in terms of 2-D and more generally 3-D hyperbolic geometry. The title of the talk (see <https://zpr.io/7Bzbagjrk7LE>) was "DMT and Hyperbolic Geometry". The talk was by a person using the name "Algekalipso" and I understand that the person in question is Andres Gomez Emilsson. The organization in question is Qualia Research Institute (<https://cutt.ly/fG05D9W>). There is also article by Emilsson (<https://cutt.ly/YG05Qrk>) with essentially the same content.

### 7.1 Can one characterize DMT experiences by using temperature like parameters

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

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

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

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

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

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

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

The model also leads to a progress in the interpretation of TGD. In particular, a geometric interpretation of p-adic length scale hypothesis [K18, K15] suggesting that p-adic length scale is accompanied by much shorter length scale of order  $CP_2$  length scale finds an interpretation: p-adic length scale would correspond to the Euclidian scale defined by a hyperbolic length scale naturally emerging for hyperbolic tessellations.

### 7.2 TGD based model for DMT experiences

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

### 7.2.1 About hyperbolic spaces

First some mathematical background.

1. Hyperbolic 3-space  $H^3$  is a generalization of 1-D hyperbola of 2-D space-time as a curve defined by condition  $t^2 - x^2 = a^2$  but with its metric being induced from the 2-D Minkowski metric  $ds^2 = dt^2 - dx^2$ . By performing all possible rotations of this 1-D hyperbola one obtains  $H^3$ .
2. In particle physics  $H^3$  corresponds to mass shell  $E^2 - p^2 = m^2$  and in cosmology to cosmic time identifiable as  $a^2 = t^2 - r^2$  in  $M^4 \subset M^4 \times CP_2$ .  $a$  defines Lorentz invariant cosmic time and is therefore analogous to absolute time invariant under Lorentz boosts which do not affect the tip of the light-cone. It is not invariant under translations however.

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

3. The value of cosmic time  $a$  characterizes the curvature of  $H^3$ . The curvature is proportional to  $1/a^2$  and the smaller the value of  $a$ , the larger the curvature and "hyperbolicity". As  $a$  decreases, one approaches the analog of the Big Bang with infinite curvature. As  $a$  increases, one approaches flat  $E^3$  in an infinite future. Cosmic evolution proceeds from the Big Bang to the future whereas DMT trip would be a travel towards the moment of Big Bang. One can of course ask whether trips could also be in the opposite time direction.
4. The lecture (see also the written version) contains a nice description of hyperbolic geometry. In particular, the volume of a ball in  $H^3$  increases exponentially as a function of its radius and this means that  $H^3$  has a lot of volume. This might be very relevant for memory storage. This can be easily understood from the visualization in terms of real hyperboloid.
5. The counterpart of plane  $E^2$  of  $E^3$  in  $H^3$  is 2-D hyperbolic space  $H^2$  and Poincare sphere gives a good view about what the projections of the tessellations of  $H^2$  look like when projected to  $E^2$ . The radial size for the basic unit of tessellations decreases with the distance from the origin whereas the region around the origin looks like  $E^2$ .

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

6. The hyperbolic geometry  $H^2$  embedded locally in  $E^3$  has the saddle property meaning that in one direction the observer is at the bottom of the valley and in another direction at the top of the hill. This property has analog also at the level of abstract geometry: geodesic lines diverge very rapidly since the curvature scalar is negative: for spheres they converge.
7. By their negative curvature,  $H^3$  and  $H^2$  allow tessellations (analogs of lattices in  $E^3$  and  $E^2$ ) which are not possible in  $E^3$ . For instance, 7-polygons are possible. The number of tessellations is infinite whereas in  $E^2$  only 17 wall papers are possible.
8. Hyperbolic analogs of plants are mentioned as fractals.

### 7.2.2 A possible interpretation of DMT experiences

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

#### 1. DMT trip as travel backwards in cosmic time

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

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

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

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

The visual field becomes more and more hyperbolic. What we would see is the projection of the patterns of  $H_a^2 \subset H_a^3 \subset M_+^4$  to  $E_t^2 \subset E_t^3 \subset M_+^4$ , where  $a$  is cosmic time and  $t$  is the linear Minkowski time.

3. At the next step the 2-D patterns in  $H^3$  are replaced by patterns in  $H^3$  as hyperbolic analogs of curved surfaces in  $E^3$  and one can say that the dimension of the visual field becomes 3.
4. In TGD Universe space-time surfaces are minimal surfaces [?] and analogous to 4-D soap films spanned by frames appearing as singularities where minimal surface property and also the determinism of field equations fail so that the frames are space-time correlates as seats of non-determinism. The saddle property of minimal surface could explain the appearance of the "hyperbolic plants" which Emilsson lists as part of DMT experience.

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

#### 2. Algebraic complexity of the experience as a second parameter

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

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

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

### 7.3 Possible implications for the interpretation of TGD

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

#### 7.3.1 $H^3$ is ideal for information storage and holography

The hyperbolic radial distance  $r_H$  in  $H^3$  from origin is given by  $r_H = a \operatorname{arsinh}(r_E/a) \simeq a \log(r_E/a)$ , where  $r_E$  is the Euclidean distance in  $E^3$ .  $r_H$  depends logarithmically of  $r_E$  slowly. The area

$S = 4\pi a^2 r^2$  of the hyperbolic sphere of radius  $u$  projected to Euclidean sphere with  $r$  increases as function of  $u$  as  $S \simeq 4\pi a^2 \exp(2u/a)$ . One can imbed a tree graph (say)  $m$  ranches in the node much more effectively than in the Euclidean case. One can think of the tree graphs a simple model for a neural network consisting of layers such that  $n$ :th layer has  $m^n$  nodes for

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

### 7.3.2 $H^3$ and the origin of p-adic length scale hypothesis

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

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

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

1.  $H_3$  allows tessellations playing a key role in TGD framework and the size scale of the cell of the tessellation defines a natural length scale unit  $\Delta r_H = aX$ , which could define the small scale and scales would be expressible in terms of this unit.
2. In  $E^3$  the natural scale would correspond to Euclidean lattices with constant cell size  $\Delta r_E$ . For  $r_H = \Delta r_H$ ,  $r_E = a \sinh(r_H/a) \simeq a \exp(r_H/a)$  would give  $r_E \simeq a \exp(nX) = am^{\Delta X/\log(m)}$ .
3.  $r_E = L_p = \sqrt{p}R$  would give  $\sqrt{p}R = am^{\Delta r_H \log(a)/a \log(m)}$ . p-Adic length scale hypothesis  $p \simeq m^k$  requires  $X = k \log(m)/2 \log(a/R)$ .

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

## 8 Sensory hubs drift around brain although they should not

Sensory hubs (see <https://cutt.ly/dnDuKXk>) of the sensory cortex responsible for integrated brain function are found to behave in an unexpected manner (see <https://cutt.ly/DnDuJpz>). According to the textbook wisdom, sensory hubs responsible for sensory percepts should be static structures. Sensory hubs are however drifting in time scale of months. The phenomenon is called representational drift.

Sensory hubs are groups of highly connected neurons believed to be responsible for the integration of sensory experiences. They are present already from childhood and shift during childhood from the primary sensory areas receiving the sensory input from thalamus to the association areas. The connectivity strengthens, especially at frontal areas, from birth to adulthood. Note that also this shifting can be interpreted as a representational drift but in longer scale. Could this kind of evolution of the sensory hubs be present also in time scale of months and make the drift necessary?

### 8.1 The findings

The popular article describes some examples of representational drift. The odor specific sensory hubs found by the team led by Carl Schoonover and Andrew Fink to drift around the piriform cortex is the first example. The findings are described in the article is the first example. The findings are described in the article "Representational drift in primary olfactory cortex" [J11](<https://cutt.ly/MnDiCZx>).

1. It is odor specificity that drifts. Sensory hub is clearly like a moving vortex in a flow - moving self-organization pattern of water flow rather than moving water. The connection



structure between neurons essential for the formation of associations as learning is drifting. The drift seems to involve learning, which cannot be induced by the ordinary sensory input. Could there be a "teacher" that provides virtual sensory input? Learning analogous to that encountered in AI comes first in mind.

2. In the case of odor perception studied for mice, daily sniffing slows down the drift. Why would the sensory input slow down or even prevent the virtual learning that seems to be present? Could the real sensory input interfere with the virtual sensory input?
3. Experiments using weak electric shocks to induce conditioning of neurons of the hub, show that the conditioning is preserved in the drift. Is it really neurons that are conditioned at the fundamental level? Could the conditioning takes place at some other, in some sense higher level?

Emotions are involved with conditioning. Who is the experiencer of these emotions? Does this higher level entity, kind of Mr. X, teach also the conditioning to the recruited neurons of the drifted sensory hub.

Interestingly, the analogy with dark matter is noticed by Schoonover and Fink. Maybe they suggestt that something analogous to dark matter might be involved with living matter.

Also other examples are discussed.

1. Hippocampal place cells are mentioned as a second example. Motion of an organism from position A to B is represented by certain place cells of the hippocampus, which are firing during the movement. The locus of firing place cells drifts slowly. Standard neuroscience interpretation would be as an overwriting of memories. Mice moving in a T-shaped maze are mentioned as an example. The neuronal groups in the posterior parietal cortex involved with spatial reasoning are drifting.
2. Representational drift in the visual cortex is slower or not present. Could the slowness and possible absence be due to the more complex and precise organization? Or could it be due to the presence of a continual visual input interfering with the virtual sensory input needed for the drift?

However, for the mouse that watched the same movies over many days, the drift took place. Pan-psychist might imagine that the neurons or something else related to the sensory hub got tired or bored while seeing the same movie from day to day and became a poor perceiver so that fresh neurons had to be recruited?

## 8.2 Questions

These findings just describe raise the following questions:

1. How the representational drift is possible? The new neurons must learn associations and become conditioned. Ordinary sensory input cannot take care of this. Is there some kind of virtual sensory input from mysterious Mr. X present, which teaches the conditionings giving rise to specific sensory perceptions?  
How can the conditionings be preserved in the drift? Does this Mr. X also teach the conditionings to the recruited neurons by using virtual sensory input inducing them.
2. Why does the drift occur and what would cause it? Could the neurons of the sensory hub get "bored" and become non-alert perceivers so that new neurons must be recruited? Or could one think that serving as a hub neuron or its MB is hard work and also neurons or their MBs must have "vacation" and rest.
3. Why sensory input slows down the drift? Does it interfere with or prevent the learning process of the recruited neurons?
4. Could the analogy of drifting sensory hub with a moving vortex, self-organization pattern of flow, serve as a guideline? Note that incompressible hydrodynamical flow is mathematically highly analogous to a magnetic field. Could one see neurons as particles of an analog of hydrodynamic flow or perhaps its counterpart at the level of magnetic field?

These purposefully leading questions should make it easy for any-one familiar with the TGD based view about neuroscience to guess the TGD inspired model for the representational drift. Before introducing the model, some basic ideas about the brain in the TGD Universe are discussed.

### 8.3 TGD based view about representational drift

#### 8.3.1 TGD view about sensory perception and emotions

The representational drift provides a new challenge for the standard dogma that sensory qualia are somehow constructed at neuronal level in the brain. There is also the problem that the neuronal stuff looks the same in all sensory areas: how could this give rise to so different sensory qualia.

Magnetic body (MB) defines the basic notion.

1. Magnetic body (MB) carrying  $h_{eff} = n \times h_0$  behaving like dark matter has IQ characterized by  $n$ , which is identifiable as a measure of complexity of an  $n$ -D extension of rationals associated with the polynomial defining a region of space-time surface assignable to MB [?, ?].  $h = 6h_0$  is an assumption consistent with the findings of Randell Mills [?] but it is quite possible that  $h_0$  can be smaller than  $h/6$ .

$n$  characterizes also the scale of quantum coherence at MB and this quantum coherence induces the ordinary (non-quantal) coherence of biomatter. By its higher IQ MB serves as a boss for layers of MB with smaller IQ and at the bottom of hierarchy is the ordinary matter with  $h_{eff} = h$ .

MB has an onion-like hierarchical structure and has both "small" parts with size scale of brain structure and "large" parts having size scale even larger than scale of Earth which corresponds to EEG frequencies around alpha band. Also highly connected neuron groups have both "small" MB and "large" MB. "Small" MB would have flux tubes parallel to axons and these flux tubes could induce the self-organization leading to the formation of axons and synaptic contacts.

2. The primary sensory qualia are at the level of sensory organs and the brain builds only cognitive representations (also secondary sensory representations not directly conscious to us are possible) and pattern recognition by receiving the input from the sensory organs and providing feedback as a virtual sensory input to sensory organs [?]. REM dreams and hallucinations are a good example of an sensory experience due to mere virtual sensory input. Also imagination can be understood. The picture generalizes to the level of motor actions.

Phantom limb serves as an obvious objection: if the sensation is sensory memory this objection can be circumvented. Sensory memories can be produced by electrical stimulation of temporal lobes artificially.

3. In the TGD framework the sensory data are communicated to MB by EEG and its fractally scaled variants, where the fundamental representations reside. Communication by dark Josephson photons [K10, K27].
4. Neurons are analogous to RAM memory which is organized at the MB. Sensory perceptions are kind of artworks representing standardized mental images analogous to standard patterns in pattern recognition. The selection of neurons in sensory hub can be dynamical so that drifting is possible.

Neurons need not be even near to each other physically: it is enough that the data from the neurons contributing to the same subself are communicated near to each other at MB to form a quantum coherent structure.

There is indeed evidence that neurons in the brain obey an effective hyperbolic geometric determined statistically [?]. Neurons functionally close to each other are near to each other in this geometry. Their images at MB would indeed be near to each other and this geometry would be hyperbolic as a geometry of hyperboloid of Minkowski space. One weird finding conforming with this picture is that salamander survives in a process reshuffling of its neurons [?] .

5. Sensory perceptions as standardized mental images created by a combination of a real sensory input communicated to MB and inducing as a response virtual sensory input from MB via brain to sensory organs as dark photon signals [?]. This process is analogous to pattern recognition. Pattern recognition involves teaching period and MB could serve as a teacher.
6. Emotions are associated with conditionings and they would represent higher level sensory perceptions of MB and be essential for the conditioning. The "big" part of MB would be responsible for higher level emotions and "small" part for more primitive emotions like hunger and first essential for conditioning of neurons.

### 8.3.2 The TGD inspired model model for the representational drift

The basic ideas of the TGD based model of representational drift should be rather obvious from foregoing.

1. Sensory hub is a higher level structure controlled by its MB. It is MB that experiences emotions as higher level sensory experiences by entangling with sensory organs and receiving sensory input also as dark photon signals. The highly connected flux tube structure of MB induces the neuronal connections of the sensory hub. Structural hubs are present from birth. Either the small MB of the sensory hub or its big brother would control the sensory hub by sending control signals and virtual sensory input.
2. Sensory hubs are present already in childhood. This suggests that standardized sensory mental images could be genetically determined and therefore inherited. This requires a realization of the genetic code at the level of MB.

The TGD inspired view about genetic code indeed predicts that genetic code is realized at the level of MB universally in terms of the tessellations of the hyperbolic 3-space  $H^3$  [?]. Dark proton triplets represent genetic codons and also dark genes as higher level units are realized. Chemical realization would be a secondary representation mimicking this fundamental genetic code. Dark photon communications would be realized in terms of dark photon triplets and also now also dark 3N-photons representing genes would be realized as analogs of Bose-Einstein condensates.

Also basic emotional patterns could be genetically coded and inherited to some degree. This might relate to the epigenetic inheritance of moods. The TGD based model for the genetic code indeed leads to this picture. It should be noticed that in zero energy ontology (ZEO) not only structures but also temporal patterns (functions, behaviors) are inherited [?, ?].

3. Representational drift requires that the connection structure for the neurons of a new hub is recreated by learning. Ordinary sensory input cannot generate the hubs with standardized sensory mental images at neuronal level.

Does MB as a boss teach standardized mental to neurons by using virtual sensory input just at it would do to induce standardized mental images? This would be analogous to teaching in associative learning used in AI.

4. Why does the drift occur? Why would MB recruit new neurons and teach them to produce standardized mental images?

Does something happen to the neurons of the hub such that drift becomes necessary? In TGD framework consciousness is universal so that one can ask what if I were a neuron of sensory hub. Could the MBs of neurons get bored or tired as I would do, and lose their alertness after experiencing the same mental images again and again? The notion of aging is a universal phenomenon in TGD view about life and consciousness [?]: could the MBs of the neurons of the sensory hub begin to suffer from problems caused by aging?

The sensory hubs shift from the primary areas to the associative cortex during childhood and their connectivity increases. Could this mean some kind of personal evolution at the level of the sensory hub, analogous to professional at the level of human society.

To sum up, MB might be doing for the brain the same as we are now doing for robots, that is teaching them. Could our AI technology be an externalization of what MB is doing for the biological body?

## 9 Are we all artists?: or what my “Great Experience” taught me about consciousness

I could immediately answer the question of the title: we are artists - all of us. The construction of sensory mental images is not a passive process but a creation of an artwork, kind of caricature giving a representation of sensory input optimal as far as survival is considered. This means decomposition of the sensory input to features and picking up the key features relevant for the survival.

This section is a written and slightly longer version of a talk in which I told about the role of vision in sensory experience seen in the theoretical framework provided by TGD inspired theory of consciousness. I decided to tell about my “Great Experience” around 1985 since it divides my life to two parts: life before and after this experience, and because this experience provided fascinating insights to consciousness and perception, not only visual, but also auditory perception and proprioception (body experience). I have told about this experience in my homepage (see <http://tinyurl.com/yccb73gq>) and in some material in books and articles to be found there (for instance).

There are online books about TGD proper (see <http://tinyurl.com/y89e3wn6>) and published books [K38, K3]. For TGD inspired theory of consciousness and quantum biology see the online books at my homepage (see <http://tinyurl.com/ygd318hl>) and the published book about consciousness and quantum biology [K1]. The article “Philosophy of Adelic Physics” [?] explains the recent vision about the mathematics forced by consciousness theory.

### 9.1 The time before “Great Experience”

It is good to start from year 1977, say October. After running basic courses up to licenciate courses in theoretical physics, I had spent few years in a kind of Odyssea. I had a strange conviction that I would do something great and I was fully aware that telling this openly would raise eyebrows. Many young people have this kind of conviction and there is nothing bad in this. Academic environment however destroys this kind of dreams.

I had had several unsuccessful ideas but then everything changed. I really got the idea of century as was clear from the beginning. I had been pondering a problem related to General Relativity. The notion of energy is not well-defined. This is a simple fact that even first year student should understand but Einstein’s fully deserved authority is so huge that it is useless to try to explain the problem to an average colleague. Those who realize that the problem is real, say that gravitational interaction is so weak as compared to the other interactions that you can safely see this as a beauty spot of a marvellous theory. What adds to the irony, is that the classical conservation laws play a fundamental role in quantum field theory and gravitation has turned out to be a notoriously difficult to quantize. Even superstrings and M-theory failed to realize the dream. This should put bells ringing.

As a loner I was however not aware about what is socially suitable I saw nothing problematic in pondering this problem seriously. And then it came, the idea! For God’s sake, if space-times are 4-surfaces in certain higher-dimensional space the problem completely disappears. This space would be Minkowski space with points replaced with very small compact space. It soon turned out that this vision can be regarded also as a generalization of string model with strings (then hadronic strings then) replaced with 3-D surfaces (super-string theory came in fashion for 6 years later). It took two years to realize that the choice of the embedding space is unique from the condition that the standard model interactions (electromagnetic, weak, and strong) are obtained besides gravitation.

I was so convinced about the power of the idea that I marched to meet a professor and told that I have discovered an idea of of century! And also told that I would be happy to have a research position to continue work it. After two weeks I was told that my services it the department of theoretical physics of Helsinki University are not needed anymore.

I had to find some manner to fulfil the life mission that I had just identified, and I had good luck. I got a kind of unemployment job as an office worker in the Physics Laboratory of Technical High School. I was probably expected to become a good corporate operating citizen in this manner but it was too late to do anything anymore: I wrote a thesis work about my great idea during the

next four years.

Nowadays this would be a criminal act but hippie era had left behind it kind of tolerance to new ideas and I was allowed to work rather freely with the idea. After four years work the thesis was published as article in International Journal of Theoretical Physics and J. A. Wheeler regarded the work as brilliant. I took the thesis and the referee statement and went to the same professor and told about my intentions. He did not have any other choice than to ask opinion from two professors: the first one regarded the work as brilliant and second one debunked it. Thesis had to be accepted and the professor became my formal adviser.

For a brief period I thought that days of economic anxiety would be over and it would be possible to enjoy funding and get some research position. This turned out to be impossible. I had to invent some manner to make money and at the same time develop TGD further. I went to an IT course and learned the basics. Correction fluid and typewrite were replaced by text process, which was a really big practical step forward.

I went to a job in big oil company. My task was to model de-sulphurization of oil in reactor. Nothing bad in this but this was not meant for me. I felt deep self disgust for serving two masters simultaneously while sharing my life to few months long pieces of TGD and money making. I had also to spend 3-4 hours in day to the mere driving to the job and after year or so I was mature for burnout as the term goes nowadays. I was in high fever and unable to work. No-one knew what the problem really was but certainly psychologically impossible situation was the deeper cause of it.

During this period I had the “Great Experience”. After it I was mature to leave petroleum industry and find some kind of job allowing to continue my work with TGD. Then something very positive and unexpected happened. I was invited to Schrödinger centennial and made a visit to Einstein’s summer house to talk about my work. This had dramatic effect in local authorities. I got a job as a full-time teacher in Dept of Theoretical Physics but there was no hope about research position. After 6 years I made very stupid thing and applied for “dosentuuri”: I would be docent enjoying no special salary but allowed to lecture about my own research work. In their statement two young Finnish professors labelled me as a madman and I became an academic corpse. I left the University.

## 9.2 Very intensive sensory experiences

Back to the experience. In the beginning the experiences were very intense sensory experiences. Both visual, auditory experiences, and proprioception (body experience) were very intensive. The experiences often began with an amplification of heard sounds, say sound of a refrigerator. At the same time I had sensation analogous to cold shivers travelling along spine but now through the entire body like waves. My body also began to oscillate like a bed of reeds in wind in sea. I had a strange sensation that the refrigerator is attracting me towards it! I had a fear that my mind fuses to it somehow, and often stopped the experience. What was remarkable was the extreme purity of these experiences. No sensory noise, no tingle as usually. I called this experience “whole body experience”. Now I would interpret it as a phase transition to large  $h_{eff}/h$  phase establishing macroscopic quantum coherence in the scale of the entire body.

Some examples are help to understand what was involved. Consider first purely visual experiences.

1. In my neighbor lived a couple: both were doctors. I had been for about week in fever and the wife, a very friendly woman, came to see what might be the problem with me. I was surprised to see that her face literally radiated light. Only much later I realized that this might have been the aura which some people claim to be able to see.
2. Second example of a very intense visual experience was created by Renoir’s painting. The painting describes a street cafe in spring, in May perhaps. There is erotics and flirt in the air and the faces of young people radiated light. There was extremely strong feeling of real presence. I felt like standing on the street in a frozen moment and time could start to flow again at any moment.
3. Third example. I was walking along path in wood. It was a beautiful day of May. No snow anymore. There were little ponds and the sunlight was reflected from the surface of water

and the reflection of trees on pond was like another world. There was a majestic silence and everything was shining. This kind of silence is of course not a lack of auditory consciousness as little as darkness is a lack of visual experience. I experienced that the world was completely pure without any dirt, just like my body in the whole body experience. I pondered whether all the dirt usually present in sensory experience is only due to the experiencer, rather than being a fault of reality. By replacing dirt with suffering one ends up to a problem, which so many thinkers have pondered: is suffering only the outcome of ego?

There were also intense experiences involving music.

1. The first experience was stimulated by a piece by Debussy: Golliwog’s cakewalk, a piece for children. I have though that Golliwog is a frog but I learned that this is not true: it is kind of imagined figure, rag doll (see <http://tinyurl.com/pukdj42>). The piece was played by a Japanese Hammond virtuoso, whose name I failed to find. The experience was fascinating in its surrealism and I felt how strong pulses from subconscious accompanied it.
2. Second experience involved both music and vision. I was seeing an animation about the evolution of life at Earth from TV. The music was Ravel’s Bolero. The volume of sound increased steadily symbolizing the emergence of new life forms. As one might guess, the life and to escape Earth since human kind had destroyed the prerequisites for civilized life. Also now the strange surreality was present.

For some time I thought that my sensory experience had permanently intensified, and the eventual return to a normal consciousness was a great disappointment. I find now easy to understand we cannot enjoy deep euphoria continually. The generation of mental images requires metabolic energy and this does not favor those aspects of experience, which do not directly support the survival. We are like gardeners: the plants, which are not useful plants or ornament plants, are weeds and must be eliminated. Artists can have ornament plants in their mental garden - provided they can sell them at the market!

In the market economy based on furious competition this leads to a monoculture of consciousness. People are extremely specialized due the requirement of extreme effectiveness. For instance, students are not anymore allowed to spend few years in the intellectual Odyssea as was possible in my student days - this was partly thanks to the hippie era which changed the attitudes of students. We listen the same music, see the same movies, and spend our time in internet chatting. This rise of monoculture is very similar to the rise of biological monocultures leading to the disappearance of animal and plant species.

### 9.3 “Psychedelic” experiences

At later stages of the “Great experience” there was also an active component superposing with the sensory input. - Depending on one’s attitude this component could be called hallucinatory or psychedelic. For me this component was not all hallucinatory: some of the key ideas of TGD inspired theory of consciousness emerged already during the experience and as a result of pondering this experience. These experiences completely destroyed my naïve materialistic world view about consciousness and life to which I have been harshly conditioned during 5 years as physics student. I realized that we do not have a slightest idea what consciousness and life really are. It is frustrating to see that after more than 3 decades most scientists and laymen still share the same delusion.

#### 9.3.1 Freud was right!

The “psychedelic” experience (I have no personal experience about psychedelics so that the term might be misleading!) began as I was lying in the corridor of the health center. I had a horrible head ache and I realized that keeping eyes gently closed it is not quite so intolerable. I suddenly realized that my visual field contains a kind of hydrodynamic flow consisting of points going forth and back and containing vortices. I see this kind of flow also when I am writing and have very calm state of mind: it is however much dimmer. I would like to interpret the flow in terms of something flow along magnetic flux tubes: magnetic flux is indeed mathematically analogous to incompressible flow.

There was however also something else. An array of what looked like computer monitors or cartoon boxes. In each box something very wild was taking place. Salvador Dali and Hieronymus Bosch were the artists, whose works this vision brought into my mind. The boxes contained strange creatures, half animals and half human, humans, which were half males and half women. There was sex, physical violence, blood.

I had learned about the works of Freud during my school days at age of fourteen or so, perhaps too early! During student years I ceased to take seriously his theories. This experience however forced me to realize that Freud was absolutely right about Id-ego-super-ego trinity: Id was what I saw! I had however doubts whether it can be really me who has this kind of visual imagination: could these images flow to my retina from collective consciousness?

What would TGD inspired theory of consciousness say about this. I believe that if physicist tries seriously to develop a theory of consciousness, the outcome predicts almost unavoidably a hierarchy of conscious entities since also physical systems form hierarchies. This kind of hierarchy would generalize the Id-ego-superego trinity of Freud.

It is also natural to assume that conscious entity experience the entities below it and associated with its subsystems as mental images. This has surprisingly strong implications. My mental images die and are reborn continually. I am a mental image at the next level of hierarchy, perhaps kind of collective consciousness. Also I should reincarnate! If my mental image is very unpleasant, I do not allow it to be conscious: no metabolic feed and the mental image dies! Same should apply to me as a mental image. Maybe I have been especially unpleasant mental image in the collective consciousness of the community of theoretical physicists: at least I have not enjoyed a single coin of metabolic feed during these decades!

The hierarchy of conscious entities means pan-psychism in the sense that conscious entities can exist in all scales. In TGD many-sheeted space-time, p-adic length scale hierarchy, and the hierarchy of Planck constants  $h_{eff}/h = n$  implied by the adelic physics would serve as correlates for this hierarchy. It is interesting that also the IIT (integration information theory) of neuroscientists Tononi and Koch [J4] (for TGD inspired comments see [K35, K31]) assumes pan-psychism. Neuroscientists are forced to give up the naïve brain centered view about consciousness.

### 9.3.2 Meeting the “Great Mind”

I found it very difficult to understand how I could have this extremely vivid visual imagination and concluded that I have got a contact to what I called “Great Mind”, maybe some kind of collective consciousness. I realized that I have a marvellous opportunity to ask all great questions bothering me and get answers! I also discovered that I can imagine of writing my questions on the computer screen in my visual field. The question appeared in it as beautiful calligraphy and were followed by an answer represented as a visual image, often dynamical. I understood also that there are two languages. The language of words and the language of images and there might be even a dictionary between them!

I started to build this dictionary! I wrote word and got a visual symbol as a response. Eventually I had the courage to write even the word “death”. The response was a symbol representing total blackout: all skin hair in my body stood up and I was horrified.

Eventually I also wrote a question “How long I will live?”. The answer was humorous. It was like an odometer of car with very many digits running wildly. I understood that I would live forever! Later I learned that I would re-incarnate again and again in other galaxies and even in other Universes: about the latter I could not make sense then in TGD framework and was a little bit annoyed!

The idea was there are two languages and the visual language would not be conscious to me. These language are indeed very different. Written or spoken language are very abstract: “house” represents entire equivalence class of houses, which can look very different but sharing some abstract features defining “houseness”. Very few digits are needed to express a given concept and this makes possible highly effective verbal communications distinguishing our species from others.

The image of a house (unless a symbol) provides a concrete representation of a particular house and requires a large number of bits. Images provide a holistic representation based on 2-D geometry not provided by written language or speech. Consider as an example a graph with nodes and links between them representing a structure of some complex systems with a lot of mutual relationships.

It is rather tedious to represent this using only words. Algebra and geometry clearly correspond to language as text and language as images.

Interestingly, there is some evidence that dolphins have a language based on acoustic holograms: could it be that dolphins have developed acoustic languages based on 2-D acoustic analogs of visual images. Also human languages have developed from words represented as images and only later came the abstraction decomposing words to letters having no direct meaning analogous to the decomposition DNA codons to letters. In chinese letters are still much like images.

### 9.3.3 Are there also other two-country nationals?

I had also another experience with active component. I was also now lying on the corridor of health center and looking at the tiles in the roof and listening to a quite music. The tiles were dancing in the rhythm of music and inside them something very lively was taking place. I thought that perhaps there is really another world there, and I am able to perceive this other world. I wondered whether there are also other citizens of two worlds. How to get a contact with them? I certainly cannot go and tell to anyone about dancing tiles in the roof and what happens inside them!

It however turned out that this worry was premature. I became ordinary citizen again and although I sorely yearned for these experiences. They came only occasionally when I was falling asleep and lasted for a short time. A year or two later I had however a similar experience lasting for one night. Also it had profound effect on my life.

## 9.4 We are all artists!

The “Great Experience” inspires the idea that we are all artists: the process giving rise to mental images is an active process building a kind of caricature abstracting just the relevant features and suppressing the irrelevant ones. The following argument makes this claim more precise.

1. In some cases people who are congenitally blind can get their vision back. They do not however have any use for this ability: they report only a perception of diffuse light. This suggests that the perception involves a lot of processing analogous to that occurring in the pattern recognition, in which one has input, which generates a feedback - kind of virtual sensory input - depending non-linearly on input and interfering with it. The iteration of this process leads to a standard pattern, one in the repertoire of learned patterns and the feedback is tailored so that the pattern is as near as possible to the input. For instance one half of picture can be completed to the full figure in this manner. Pattern recognition is central problem in robotics. The robot must be able to recognize same object in various lightings and orientations, or by seeing only part of it. The object must be also distinguished from other objects. Same challenge is encountered in speech recognition.
2. This suggests that the feedback is virtual sensory input propagating to the level of sensory organs, such as retina. In principle, the feedback could also stop at a higher level and never reach the sensory organs. REM sleep and oto-acoustic sounds (heard even by outsiders in some cases!) however suggest that feedback propagates down to the sensory organs. If so, virtual sensory input from brain or via brain would be an essential part of sensory perception. Brain would also give names for the objects of perceptive field created in the process and build various associations. This would also lead to standard mental images making possible communications using language: language indeed distinguishes us from the other species.

This view would strongly suggest that the sensory qualia are at the level of sensory organs: this would be very natural since they are specified to produce specific qualia. Quantum entanglement between the sensory images would bind different sensory inputs to single coherence experience. This requires macroscopic quantum coherence in the scale of entire body and in TGD the hierarchy of Planck constants  $h_{eff}/h = n$  makes this possible.

3. Phantom leg experience serves as an objection against this idea. A person without leg lost in say traffic accident can feel pain in it. This should not be possible if the leg is missing since the nerve cells are not there anymore. Neuroscientist concludes that sensory qualia are generated at the level of brain and the pain is in the still existing sensory map of the leg. Sensory qualia should be assignable to the sensory areas. The problem is that nothing in the



structure of neuronal circuitry suggests an explanation for why the qualia are so different in various sensory areas.

The most natural TGD based explanation is that pain in the non-existing leg is pain in the leg, which still exists in the geometric past - sensory memory. Sensory memories are indeed possible. Idiot savants are capable of memory feats (say drawing a memory of a landscape in full detail or playing music piece that they have heard), which could be understood if they have sensory memories as genuine sensory experiences. Also ordinary people can have sensory memories if neurons in temporal lobes are excited electrically. A good reason for having no sensory memories is that they would interfere with sensory input and one would not know what time one is living in! I remember that my Grandma lived at very old age many years in her childhood. She was even going to a ball! Wonderful gift to lift youth again after long and hard life!

This makes sense in zero energy ontology (ZEO) in which perceptive field corresponds to a 4-dimensional causal diamond (CD) identified as the intersection of future and past directed light-cones. That sensory memories can be generated by the electrical stimulation of temporal lobes even in ordinary subject person supports this view. This could also explain why persons with about 10 percent of brain left can survive: they could use the brains of their geometric past.

4. What about imagination in this framework? Imagination is almost experiencing: almost seeing, almost hearing. Internal speech is almost talking. This suggests that the virtual sensory input from the brain or via the brain (from magnetic body) almost reaches sensory organs but not quite. For instance, in the case of vision signal could propagate down to the nuclei known as optic chiasma but not below it. Note that the sensory feedback in sensory perception should propagate down to the sensory organs if sensory qualia are there. The barrier preventing the generation of genuine virtual sensory input could however overcome in special situations and induce hallucinations or psychedelic experiences. Same applies also to imagined motor actions.

In adelic physics imagination can be understood in terms of p-adic space-time sheets. Strong form of holography (SH) allows to continue 2-D data at certain 2-surfaces to 4-D surface in p-adic sectors of the adele thanks to the phenomenon of p-adic pseudo-constants replacing integration constants with piecewise constant function depending on finite number of binary digits in partial differential equations. What is imaginable in this sense is not however always realizable since in the real sector integration constants are indeed constants and there is no flexibility of this kind! In the recent case imagination realized as p-adic perception would not allow continuation to a full perception in real sense and signal would not propagate to the sensory receptors.

5. What happened in the Great Experience? It seems that somehow the feedback associated with imagination managed to leak through the barrier preventing its manifestation as a genuine sensory input. Quantum criticality would be in question. Hallucinations, psychedelic experiences, dreams, and the experiences occurring when one falls asleep or wakes up, provide examples of this. This kind of leakage cannot happen always since it would be very dangerous. Brains are known to have its own psychedelic, DMT: could it have a role in making REM dreams possible?

Tesla is a well-known example of a person who saw his thoughts. This made him a technological genius. Many great composers have also heard music directly. For instance, Tchaikovsky suffered in his childhood from the continual music played in this head. Oliver Sacks tells about this kind of experiences in his book "Musicophilia" [J8] (see also the article [J8]).

The conclusion would be that we are artists of our own life. If one wants to build a better world, one could ask whether there could be some kind of program for achieving this. Could it be a good idea to use more hours for art in the elementary school and in all education? The challenge would be to motivate the children to realize that they can learn to virtuosos of sensory perception and perhaps even artists in the ordinary sense of the word.

I know from a personal experience that this is possible. At the age of twenty the music of many composers left me cold: I could not comprehend it. After more than four decades I can enjoy

almost any music provided it is complex enough. Also morning walk is a marvellous experience and with my eyes suffering from cataract I probably see much more than with the eyes of of twenty-year old! Our senses are the best gift that we have and at least in this age one can enjoy life by just perceiving.

## 10 Fatima Marian Apparitions And TGD Inspired Theory Of Consciousness

The MARIAN Project is an acronym form Multicultural Apparitions Research International Academic Network. Its funded on the data and results obtained by the trilogy books by the Portuguese historians Fina d'Armada and Joaquim Fernandes, since 1982 to 2002 [H2]. There is also a book by Vallee [H4] about Fatima apparition phenomenon.

The Project will take a deep look into a few clues, such as:

1. Identities and differences among human extraordinary experiences, i.e. OBEs, NDEs, AASs (Alien Abduction Scenarios) and MAs (Marian Apparitions), from the narrative, hermeneutic and sociopsychological levels and also cultural/religious backgrounds;
2. Neurophysiological details and all experimental elements that could be tested in laboratory, as the very common “buzzing” sounds heard by several witnesses at Fatima spot near the oak contact only when the Lady, according to Lucia, was speaking with her. This is the most hard clue ever depicted for a case of an hypothetic geomagnetic variables influence (very low magnetic fields?) tested in lab. by Michael Persinger and his team in Laurentian University [J6] .

In the sequel I shall comment Fatima Marian Apparition from the point of view of TGD inspired theory of consciousness. I base the discussion on what I learned about Fatima Marian Apparition via email exchanges with Joaquim Fernandes and some web sources. The basic data items used in the sequel are following.

Three children, Lucia, Fransisco, and Jacinta met a brilliantly effulgent lady whom they identified as the Virgin Mary. This occurred six times at 13th of each month. The so called Sun miracle was witnessed by people in a large area measured about 20-30 miles (it is estimated that about 70.000 people congregated in the vicinity of Cova de Ira to witness the predicted miracle!).

The witnesses reported a light tunnel and little image of Mary at its center. Also reported were heat waves with sudden drying of clothes, healings, fall of white filaments (“hair angle” ), and a strange auditory sensation defined by some witnesses as a “buzzing of bees within a vase”. This sound was heard *only* when the seer Lucia told that “the Lady was talking to her *without* moving the lips”. Also glowing globe-shaped vehicle appeared suggesting a similarity with UFO experiences.

### 10.1 General TGD Based Model

The TGD based model for Fatima Marian Apparition relies on the notion of self hierarchy allowing identify the entity “Maria” as a collective higher level self, a real conscious field entity receiving information from human brains by TGD counterparts of EEG waves, realized perhaps in magnetosphere. The visions and also some experiences of witnesses could involve in an essential manner quantum entanglement with “Maria” allowing sharing and fusion of mental images: no classical communication is needed. Quantum entanglement is the basic mechanism of remote mental interaction and remote healing: the occurrence of healings during Fatima apparitions were indeed reported. Microwave static, known to correlate with taos hum phenomenon involving sometimes also buzzing sounds [I6], is a possible candidate for the inducer of TGD counterparts of intense EEG waves by a general mechanism to be discussed. Also tectonic activity could have generated microwaves. Microwave static explains the buzzing sound as microwave audition [I5]. The presence of a plasmoid like structure serving as a relay station entangling with both seer and “Maria” could have generated light at visible and infrared frequencies and induces effects like heating and drying.

### 10.1.1 Self hierarchy and collective levels of consciousness and “Maria” as a conscious field entity

The basic notions of TGD inspired theory of consciousness are quantum jump between quantum histories identified as a moment of consciousness and self, which is essentially a pile of quantum jumps integrated to single experience. The sequence of quantum jumps corresponds to subjectively experienced time which is in principle separate from the geometric time of physicist.

The preservation of self identity means that self does not generate bound state entanglement with the external world and remains thus quantum autonomous system during the subjective time development by quantum jumps. The generation of entanglement leads to a loss of consciousness: one can say that everything is conscious but consciousness can be lost. Selves form a hierarchy having the hierarchy of space-time sheets as a geometric correlate. Fusion of two space-time sheets by flux tube is the geometric correlate for the generation of entanglement. Sub-selves of two separate selves can entangle and this results in a fusion and sharing of a common mental image. This mechanism provides a general explanation of various remote mental interactions, such as telepathy, remote healing, and collective experiences. Also phenomena like apparitions and UFO experiences can be explained in terms of remote mental interactions.

In TGD universe any system has besides the visible, physical, body also field (magnetic) body, which has much larger, actually astrophysical size in the case of humans. What I call personal sensory representations are realized at the personal magnetic body of astrophysical size. Second type of sensory representations (third person view) would be realized at the magnetosphere of Earth and would give rise to multi-brained electromagnetic selves representing collective levels of consciousness. Amazingly, plasma sheet at the night side of Earth’s magnetosphere is known to be a highly self organizing structure and the ionic velocity distributions represent features like “eyes” and “wings” [F10]. Even religions could represent to collective levels of consciousness having a rich repertoire of mental images like Maria and saints.

The simplest working hypothesis is therefore that the entity “Maria” is self, a completely real conscious entity, at a higher level of self hierarchy. In TGD framework any self defines a mental image of higher level self having it as a sub-self. The conscious entity “Maria” could communicate with humans using quantum entanglement making possible telepathic sharing and fusion of mental images.

1. The most obvious identification of “Maria” is as a mental image of a collective multi-brained consciousness realized at the magnetosphere and having only the field body. This would explain the cultural, standardized aspects of the vision.
2. One can consider also the hypothesis that the luminous “Maria” was analogous to UFO and in TGD framework identifiable as plasmoid, electromagnetic life form in TGD Universe, in the lower atmosphere, perhaps generated by tectonic activity. The physical effects associated with Sun miracle indeed suggest the involvement of a plasmoid like structure. The identification as Virgin Maria would thus reflect only the cultural background. It is however not obvious how plasmoid like primitive conscious entity could have predicted the occurrence of Sun miracle beforehand.
3. A compromise of this views is that plasmoid like structure was involved and served as a relay station entangling with both seer and “Maria”, just like in TGD based model of UFO experiences. This option gives better hopes of explaining the physical effects involved and allows a lot of freedom in the identification of “Maria”: even the identification as an extraterrestrial becomes possible.

### 10.1.2 Many-sheeted space-time, topological field quantization, and extraordinary experiences

In TGD Universe space-times are 4-dimensional surfaces of certain 8-dimensional space-time. Many-sheeted space-time is the basic prediction of TGD and means roughly that various structures that we see in various length scales correspond to space-time sheets with outer boundary glued by tiny wormhole contacts to larger space-time sheets representing larger structures containing them.

Topological field quantization distinguishes between TGD and Maxwell’s electrodynamics. What happens is that em field and classical fields in general decompose into flux quanta represented

by space-time sheets. For instance, radiation field decomposes into cylindrical structures carrying em fields propagating with light velocity. These structures (“massless extremals”, MEs [K19]) are ideal for classical communications: classical signal propagates with light velocity inside a cylindrical tube and without weakening making high precision targeted communication possible, and the non-determinism of the associated vacuum current propagating also with light velocity allows a coding of arbitrary signal. At quantum level MEs serve as field bridges making possible quantum entanglement allowing sharing and fusion of mental images among other things. The mirror mechanism of long term memory relies on MEs allowing entanglement between geometric past and now and resulting in sharing of mental images.

Magnetic flux tubes and their electric counterparts represent also general solution families to field equations [K21, K20]. The flux tubes of Earth’s magnetic field are super-conductors in TGD Universe and this super-conductivity is crucial for life. Closed magnetic flux tubes plus ions and their electric duals (involved with bio-electrets and liquid crystals and also with cell membrane) are the fundamental electromagnetic life forms around which ordinary bio-matter self-organizes.

Magnetic flux tubes are an essential element of the model of sensory representations on magnetic sensory canvas. Schumann resonances transmit horizontal communications between brains and could make possible collective shared experiences characteristic for Fatima case. Hypnagogic states give also rise to analogous experiences and probably involve Schumann resonances. The nodes of the super-conducting circuitry formed by the magnetic flux tubes could be of special importance for phenomena involving communications with higher levels of self hierarchy. Therefore special geomagnetic features could characterize the places where apparitions occur.

Water has an especially complex many-sheeted space-time structure and the proposal of A. Brodziak [H1] is that the spring water associated with places where apparitions have occurred plays some important role. We ourselves consist mostly of highly self-organized water and it would not be surprising if water would have varying degree of self-organization depending on external parameters such as the structure of the local magnetic field. Perhaps highly self-organized water helps to generate the quantum entanglement.

There are strong resemblances between TGD based models for UFO experiences, NDE experiences and Marian apparitions. Also in the case Fatima apparition structures which might have been interpreted as UFOs in our cultural context appeared and even “Maria” could have been interpreted as UFO in modern cultural context. The TGD based model of UFO experiences discussed involves in an essential manner quantum entanglement between conscious electromagnetic entities (plasmoids), and unifies Persinger’s theories [J6] with the view that ETs are real, although not in the sense usually thought. Plasmoids could be seen as advanced counterparts of spaceships having a rather ghostly crew consisting of mental images (sub-selves) entangled with the magnetosphere of some distant astrophysical object serving as its telesensory system and able to entangle also with the person having UFO experience. Translating directly to this case this would mean that plasmoid like structure in the vicinity of the apparition place would have served a role of relay station entangling with both seer and entity “Maria”, which could have been even extraterrestrial intelligence.

### 10.1.3 Did “Maria” communicate quantumly or classically?

Taking seriously the idea about “Maria” as a collective conscious entity and a mental image of some collective self communicating from magnetosphere, one is led to ask how this communication could have occurred.

1. If the communication occurred purely quantumly just by entangling collective mental image/self “Maria” with the mental image of the receiver, the topological field quanta of EEG would have acted only as entanglers but not as carriers of classical information. This mechanism is extremely robust since there is no need to code information to a classical signal. TGD based model of long term memories relies on this mechanism. Very metaphorically: to have a long term memory from moment two years ago is to look at quantum mirror at distance of one light year. The attribute “quantum” means a telepathic sharing of mental images between sender and receiver. No storage of memories of past to recent moment of geometric time is needed. The immediate implication is that length scales of order light life are relevant for human consciousness: against this background magnetic sensory canvas hypothesis does not look so radical.

In this case the task is to generate topological field quanta of EEG which are intense enough to generate sufficiently stable and long lasting bound state entanglement between “Maria” and receiver making possible sharing of mental images by quantum entanglement. This requires only that a sufficient amount of energy is transformed to the energy of EEG MEs at definite resonance frequencies so that the mechanism is very robust. plasmoid like structure could have served as kind of relay station entangling with both seer and “Maria” and perhaps also inducing at also visible radiation inducing heat waves and drying effects. Microwaves are not plausible candidates for causing heat waves since they might have caused too much biological damage.

2. One can imagine also classical, non-telepathic communication in which topological field quanta (topological light rays) carry classical signals regenerating the sound percepts in the brain of the receiver. This model raises many challenges: what is the code of communication for the classical signals, how the sender can resolve the problems caused by the fact that this code probably depends on receiver (by feedback one might hope), etc... Clearly, Occam’s razor does not favor this option.

#### 10.1.4 What was “real” and what was “hallucinatory” ?

The basic question relates to what reported effects had local physical correlates and which represented shared mental images. The microwaves possibly explaining the buzzing sound should have been real. The buzzing sounds themselves could have been purely endogenous. The reported glowing globe-shaped vehicle might have identification as a real plasmoid like structure. Even what was identified as “Maria” could correspond to a plasmoid like structure in the vicinity of the place of apparition. The “Sun turning around” is an excellent candidate for a plasmoid like structure. The radiation responsible for effects like heat waves and drying of clothes must have been real and perhaps induced by plasmoid like structure emitting at least visible light resulting in ionization of the atoms of atmosphere.

Collective sharing of mental images with plasmoid like structure entangled with “Maria” could explain the collective “hallucinatory” aspects of the experience. These self-organizing conscious structures could reside also in the outer magnetosphere, say in the plasma sheet at the night side of Earth [F7]. The reports about light tunnel with the image of little Mary at the center and about pouring of flower petals would suggest a collective experience based on the sharing of mental images.

#### 10.1.5 Healing effects

TGD provides a general theory of remote healing relying on quantum entanglement occurring even in astrophysical length scales and involving collective selves [K26]. There is support for the view that remote healing is possible even when the healer does not know the patient personally or where the patient lives. As if there would be a third party involved, a collective multi-brained higher level self, for whom the data, which is insignificant for healer, makes sense. Also the well documented healing effects of prayer and meditation groups can be understood if there is this third party. In this case this collective self would be “Maria”.

## 10.2 The Mystery Of The Buzzing Sound

The witnesses of Fatima Marian Apparition report buzzing sounds like bees in a vase. It would be interesting to determine the frequency spectrum of the buzzing sound produced by bees: presumably it results from the periodic motion of wings. Also one could test how strongly the sensation depends on the average frequency and to what degree the shape and phase relationships of Fourier spectrum are responsible for the sensation.

### 10.2.1 Meteor sounds, taos hum, and physiophonic sounds

The buzzing sound might relate to several other strange sound phenomena like meteor sounds, taos hum, and physiophonic sounds. These exotic sound phenomena are discussed in [K14].

1. A strange finding supporting the TGD view about sensory representations is that, contrary to expectations, the sounds generated by em fields of meteors have fundamentals around 40 Hz thalamocortical resonance band responsible for sensory representations [F14]. This sound is like “pop”, not buzzing, but frequency spectrum might be nearly the same. One might check whether 40 Hz frequency band is involved also with the buzzing sound produced by bees.
2. Taos hum [I6] is a strange phenomenon which might relate to the microwave audition. No source for this sound, which has frequency spectrum in the range 40-80 Hz, has been identified. Taos hum seems to be an endogenous sound generated by classical em or  $Z^0$  field which does not penetrate outside the body. Buzzing sound is also sometimes associated with taos hum. If the buzz has the character of taos hum, this would require that sounds heard also by the witnesses were endogenous and not recordable by microphones. There is strong correlation between taos hum and so called microwave static having poorly understood biological origin [I6].
3. Physiophonic sounds are endogenous sounds produced by electric stimulation of skin. One can transform speech to electric signals applied to skin and experienced as comprehensible speech. Physiophonic sounds are probably closely related to taos hum.

### 10.2.2 Microwave hypothesis

It has been proposed [H2] that so called microwave audition [I5] could be involved with the mysterious buzzing sounds reported by witnesses of the Fatima Marian Apparitions. There exists a standard physics explanation for microwave audition based on thermal effects caused by microwaves inducing small pressure pulses [I5]. This explanation is however subject to objections to be discussed later and TGD suggests an alternative mechanism.

According to [H2] French and Canadian researchers have found interesting results using a source of microwaves on the subjects heads: one of the sounds type heard was a “buzzing”. The source was between 200 and 3000 MHz with a mean intensity of from 0.4 to 2  $mW/cm^2$  to a density level of above 300  $mW/cm^2$ . The modulating frequencies ranged from 200 to 400 Hz. According to [H2], the insect sounds resulting from the motion of wings could be put between that interval. An order of magnitude for the resonance frequency of body guessing the sound velocity to be  $v = 300$  m/s in body and body to have a size of order  $L = 1$  m is  $f \sim v/L = 300$  Hz. Microwaves could correspond to microwave static of biological origin [I6] or be generated by plasmoid like structures.

Microwaves has been proposed as an explanation for the other physical effects reported in Fatima apparitions, namely those associated with the so-called Sun miracle when the people saw the “Sun” turning around itself and produce a heat wave that dry the soil that moments before has been wet by a sudden rain, as well the clothes of people in the spot, also wet. The problem with this explanation is that microwaves with the required intensity might have had drastic physiological effects: there is no known evidence for this. A more plausible explanation is that the plasmoid like structure playing the role of entanglement relay station induced these physical effects at visible and infrared wave lengths and was erratically identified as Sun. Ionization of atmosphere would have indeed induced emission of visible light.

Most importantly, microwaves could accompany EEG MEs by a mechanism to be discussed later: these topological field quanta in turn make possible quantum entanglement and sharing of mental images. Topological field quanta corresponding to 40 Hz resonance band are especially interesting candidates in this respect since in TGD based model they are responsible for sensory representations at magnetic sensory canvas.

## 10.3 Microwaves, Consciousness, And Life

The TGD counterparts for strong EEG waves are topological field quanta (electromagnetic bridges or topological light rays connecting seer with “Maria” ) generating quantum entanglement making possible the sharing of mental images. Also witnesses could participate in the vision (image of Mary in the center of the cylindrical light tunnel, Sun turning around). Microwaves received by the brain and possibly by the body of the seer and also witnesses (creating sensation of buzzing

sound) could have generated topological field quanta of EEG waves and induce as a byproduct also microwave hearing [I5] responsible for the sensation of buzzing sounds.

### 10.3.1 Support for the importance of microwaves

Microwaves span the wavelength range 1 mm -30 cm corresponding to the frequency range 300- 1 GHz. Note that the size of the dots in X-ray film was of order one 1 milli-meter and corresponds to the upper limit of 300 GHz for microwave. There is support for the importance of microwaves for living systems coming from various anomalous phenomena involving microwaves.

1. Microwaves in GHz range are found to be involved with water memory and homeopathy [I1]. Microwave frequencies are accompanied by ELF frequencies such that the high and low frequencies  $f_{high}$  and  $f_{low}$  are related by the scaling law to be discussed later.
2. Microwave hearing [I5] is a phenomenon in which microwaves in the frequency range.2-3 GHz (wavelength range 150-10 cm) induce a hearing sensation. There is evidence that ears are not involved with the microwave hearing [I2]. The average pressure of the radar wave at the threshold of hearing is roughly three orders of magnitude less than the average pressure of a sine wave in air at the threshold of hearing air waves. Second, the location of the most sensitive area for hearing radar is remote from the ears, on top of the head. Third, the subjective frequency spectrum seems to include higher frequencies for radar hearing than for normal hearing of air waves. Fourth, the direction from which sound seems to come does not change as the head is turned about in the radar field.
3. Microwave static of biological origin having strong correlation with taos hum [I6] and taos hum could be seen as a particular case of microwave hearing [K14].
4. The proposal of Joaquim Fernandez [H2] that microwave hearing would also explain the strange buzzing sounds reported by the witnesses of the Fatima apparitions served as a clue to the TGD based model of this phenomenon. The model led to the realization that quite a many apparently unrelated phenomena rely on a general mechanism of remote mental interactions in which microwave MEs propagate like mass-less particles inside ELF MEs, which generate the entanglement between remote subjects and thus make possible sharing of mental images and remote realization of intentions. Microwave MEs in turn induce self-organization at the end of the receiver. The same mechanism is involved also with the endogenous realization of intentions and remote healing.

### 10.3.2 Breaking of super-conductivity in many-sheeted space-time and microwaves

The transfer of charged particles between space-time sheets is possible provided so called flux tubes connecting the boundary of a smaller space-time sheet to the boundary of a larger space-time sheet are generated [K7]. Particles simply flow along this bond connecting the space-time sheet to the larger space-time sheet, say magnetic flux tube, and also vice versa. This mechanism leads to the breaking of super-conductivity since super-conducting matter from the magnetic flux tubes, which can be at extremely low temperature, flows to the atomic or possibly some other space-time sheets.

Microwave radiation could generate flux tubes. The energies of microwave photons in the wavelength range 1-100 mm are in the range  $10^{-5} - 10^{-3}$  eV and correspond to the temperature range .1-10 K. The critical temperatures for low temperature super-conductors are in this range. One can interpret this by saying that super-conductivity is not destroyed by the heating of the magnetic flux tubes but by the generation of the flux tubes with bond energy of order of the gap energy causing the leakage of the supra current to non-super-conducting space-time sheets and thus inducing dissipative effects.

### 10.3.3 Microwaves and biological control circuitry

The basic vision of the TGD inspired theory of consciousness [K16] is that everything is conscious and consciousness can be only lost. This philosophy naturally leads to the view that plasma structures consisting of closed magnetic flux tubes plus atomic space-time sheets containing plasma ions represent primitive life forms. All life forms metabolize. In the case of plasmoid like life forms

micro-waves induce a primitive metabolic cycle in which ions are transferred from the magnetic flux tubes to atomic or some other space-time sheets, where they dissipate and induce ionization and UV and visible light and then “drop” back to the magnetic flux tubes. If the intensity of the magnetic field is about 2 Tesla, which by the quantization of magnetic flux, corresponds to p-adic prime  $k = 157$  and p-adic length scale of 80 nanometers), electronic cyclotron transitions generate microwaves with frequency of about 2.4 GHz and the system can thus generate its “food” itself.

Microwaves can also “kick” ions from magnetic flux tubes to  $k = 151$  space-time sheets since the zero point kinetic energies for  $k = 151$  correspond to microwave frequencies. It seems that the process involves at least the following space-time sheet:  $k = 137$  (atomic),  $k = 151$  (cell membrane),  $k = 157$ , and  $k = 169$  (magnetic flux tubes of Earth’s magnetic field). UFOs are often observed near the lines of the tectonic activity could represent this kind of life form using the energy of microwaves of tectonic origin (quartz crystals are piezoelectrics and can amplify wide range of microwaves) as their “food” and therefore following the microwave beam emanating from the spot of tectonic activity. Also the UFO like structures associated with the Fatima apparition could be plasmoid like life forms.

In the living matter the same simple biological Karma’s cycle has developed to an extremely complex many-sheeted circuitry in ionic flow equilibrium and controlling the homeostasis [K12]. Microwaves radiated in the conformational transitions of proteins and possibly amplified by the rotational transitions of water molecules and clusters of them mimicking the rotational spectra of molecules generate bridges connecting super-conducting space-time sheets and atomic space-time sheets and thus sustain the dynamical circuitry. If some protein fails to be expressed genetically, this implies the absence of certain microwave frequencies so that corresponding bridges are not present and erratic functioning of the current circuitry result. Medicines and homeopathic remedies in which water clusters mimic the rotational spectrum of the medicine molecules generate the microwave spectrum of the proteins, which are not expressed.

The average number of the bonds per say area element is the natural measure for the effectiveness of the bridge, and the increase of the microwave radiation intensity at some frequency increases the effectiveness of the corresponding bond and thus modifies the homeostatic equilibrium. Electromagnetic radiation in microwave range is known to be lethal to micro-organisms: this could be due to the transformation of the biological current circuitry induced by the radiation. Too high leakage of supra-currents to atomic space-time sheets might be also fatal. Personal computers and travel phones produce microwave radiation and this raises interesting questions about their role in modifying many-sheeted current circuitry and thus modifying the homeostasis. One can also wonder about the role of this radiation in electric allergies.

### 10.3.4 Microwaves and the mechanism of remote intentionality

TGD based model of remote mental interactions is discussed in [K26]. The model is based on the notion of bound state quantum entanglement having as a geometric correlate the formation of so called flux tubes. Magnetic flux tubes as well as topological field quanta of radiation (“mass-less extremals”, or briefly MEs [K19] ) could act as such bonds. Many-sheeted space-time makes in principle entanglement possible in even astrophysical time scales. Also time-like entanglement is possible by the non-determinism of the basic variational principle and is provides quantum mirror mechanism of long term memory [K28] ). Essential is also the notion of adjunct serving as a kind of relay station entangling any two subjects during remote mental interaction, say healer and healed, and inducing sharing and fusion of mental images and making possible also classical communications. An object possessed by the healer or healed is one example of an adjunct.

The entanglement is generated by mass-less extremals having a length, which is a multiple of the wavelength of the radiation involved and therefore the frequencies involved are typically ELF frequencies. On the other hand, the work done after developing this model has shown that also microwave MEs are probably involved. Human intention could be able to generate microwave MEs giving rise to the bonds between magnetic flux tubes and atomic space-time sheets also outside the body. Brain and body certainly generate microwaves (GHz frequency scale corresponds to protein and DNA conformational dynamics and water’s rotational transitions), and the intention could be remotely realized as these microwaves if the system is sensitive to the microwaves. The problem is to understand how ELF MEs and microwave MEs are related to each other.



### 10.3.5 How microwave MEs and ELF MEs are related?

The existing TGD based model for remote mental interactions is based on ELF (extremely low frequency) MEs serving as field bridges between sender and receiver and inducing entanglement. Also microwaves must relate closely to the remote realization of intentions. The question is how these two aspects of remote mental interactions are related.

1. ELF MEs are crucial for the sensory representations at the personal magnetic canvas and on the magnetic flux tubes structures in magnetosphere. The simple “feeling of existence” is generated by cyclotron transitions and the most effective manner to generate these is to “kick” super-conducting ions first to the atomic or some other space-time sheet. The ions having large zero point kinetic energy can “drop” back to high  $n$  cyclotron states at the magnetic flux tubes and decay by emitting a large number of ELF photons. Microwaves might be responsible for generating the bridges making this flow of ions to the atomic space-time sheets possible. Microwaves could also “kick” ions from magnetic flux tubes to  $k=151$  space-time sheets and the “dropping” of ions back by photon emission would generate further microwaves.
2. Magnetosphere is expected to contain plasmoid like life forms defining sensory representations getting input from biosphere. Microwaves are the “food” of the plasmoid like life forms and the question is where these life forms get their food from: from biosphere or from brains perhaps?
3. The so called scaling law [K12] predicting that high and low frequency MEs somehow accompany each other, helps to understand the situation more clearly. The scaling law abstracted from the findings summarized in [I1] reads as

$$f_{high} = (c/v) \times f_{low} \quad , \quad c/v = 2^{137-k} \times 2 \times 10^{11} \quad .$$

Here  $v$  is some velocity associated with the system transforming low frequency waves to high frequency waves and vice versa and  $k$  is prime of power of prime defining so called  $p$ -adic prime  $p \simeq 2^k$ , labelling the space-time sheets of the many-sheeted space-time and characterizing their sizes.  $k = 137$  corresponds to the space-time sheets of atomic size and gives  $c/v = 2 \times 10^{11}$ .  $k = 151$  corresponds to the cell membrane length scale and gives  $v \simeq 6$  m/s, the phase velocity of alpha waves at the surface of skull.

TGD allows to understand the mechanism behind the scaling law:  $f_{high}(k)$  corresponds to zero point kinetic energy of an ion at the space-time sheet labelled by  $k$ , and flow to cyclotron frequency at the magnetic flux tube of Earth’s magnetic field: both these energies are inversely proportional to the mass of the ion.  $k$  refers to the space-time sheet from which the ion “drops” to the magnetic flux tube. The value of  $c/v$  is inversely proportional to the local value of Earth’s magnetic field and thus varies somewhat. In the case of  $k = 151$  this could explain the variation of the nerve pulse conduction velocity and EEG phase velocity.

The problem is to understand how EEG MEs and microwave MEs are related. It has been already hypothesized that they implicate each other and TGD provides mechanisms for how this is possible. A more detailed hypothesis is that the ELF MEs serve as entangling em bridges along which the microwave MEs propagate like mass-less particles to the magnetic sensory canvas to be used by the plasmoid like life forms. The ions are “kicked” by microwaves to the atomic or possibly also other space-time sheets and “drop” back to high  $n$  cyclotron states which then decay by cyclotron radiation in ELF energy range. This self-organization process generates the simple “feeling of existence” mental image at magnetic sensory canvas entangled with more complex mental images in brain.

### 10.3.6 Microwave hearing

The previous findings encourage to think that microwave hearing involves the transformation of microwaves to EEG waves responsible for entangling brain with the magnetic sensory canvas. It might be that microwave beam actually induces the transfer of ions from magnetic flux tubes to atomic space-time or cell membrane space-time sheet (say), which then “drop” back and in

the latter process induce also cyclotron radiation at EEG frequencies generating the auditory experience. Interestingly, for  $k = 151$  the zero point kinetic energies of ions are in microwave range and the “dropping” of ions from cell membrane space-time sheets to magnetic flux tubes of Earth could be involved with the amplification of both microwaves and generation of EEG waves by cyclotron transitions at magnetic flux tube. The velocity parameter  $v$  corresponds in this case to alpha wave phase velocity at the surface of skull. The lowest Schumann resonance at 7.8 Hz is in alpha band and there are reasons to believe that it is closely related to the UFO experiences and thus also to Fatima apparition.

In TGD universe these EEG MEs would project directly to the auditory magnetic canvas and generate the experience. Of course, one could argue that the modulation of EEG wave by a frequency higher than EEG wave does not make sense. There is actually however no reason forbidding “fast modulation” analogous to small ripples on sea waves and this kind of representation has been proposed to give rise to “features” [?] in alpha band [K14]. The fast modulation could also occur with respect to subjective time: the fast modulation of the number of EEG MEs with respect to subjectively experienced time (defined by quantum jump sequence) is also possible: in this case there would be no modulation with respect to the geometric time. If the space-time sheet associated with brain and various brain structures (the sizes are correct!) serve as a receiving microwave antennae they could also act as active emitting antennae.

The amplification of microwaves could be seen as a maser like mechanism in which ions are pumped to  $k = 151$  space-time sheet by microwaves. The existing microwave photons stimulate the dropping of ions back and thus also the generation of new microwave photons.

In many-sheeted space-time particles topologically condense at all space-time sheets having projection to given region of space-time so that this option makes sense only near the boundaries of space-time sheet of a given system. Also p-adic phase transition increasing the size of the space-time sheet could take place and the liberated energy would correspond to the reduction of zero point kinetic energy. Particles could be transferred from a portion of magnetic flux tube portion to another one with different value of magnetic field and possibly also of Planck constant  $h_{eff}$  so that cyclotron energy would be liberated.

If the “dropping” of ions from  $k = 151$  space-time sheet amplifies the microwaves, microwave hearing is predicted possible from 3.75 Hz (He cyclotron frequency 75 Hz) down to frequencies.16 GHz corresponding to delta band (1.5 Hz cyclotron frequencies possible for heavy ions). Delta band dominates during deep sleep and the model of magnetospheric sensory representations predicts that brains can entangle with the plasma sheet by EEG MEs at delta band. This could correlate with the appearance of microwave static at nighttime [I6]. Perhaps delta waves entangle sleeping brains with magnetospheric selves and microwaves feed energy to the corresponding mental images. The plasma sheet at the night side of the magnetosphere is indeed known to contain self-organizing plasma structures with ionic velocity distributions representing features like “eyes” and “wings” [F10]. The prediction is that heavy ions should play important role in the generation of EEG during sleep.

The resulting unification would be rather economical. The formation of sensory representations, remote mental interactions, homeostasis, and homeopathy would all rely on the same basic mechanism: high frequency MEs propagating as mass-less particles along low frequency MEs. Low frequency MEs would induce quantum entanglement and high frequency MEs would force self-organization at the end of the receiver.

### 10.3.7 Do electromagnetic life forms “eat” microwave energy?

In the case of UFO experiences, and perhaps also in the case of Fatima Marian apparition, microwaves, possibly generated by the tectonic activity, could have also a further important function besides entangling brains with the conscious entity involved. According to the TGD based proposal, so called plasmoids consisting of closed magnetic flux tube structures carrying supra currents plus atomic and  $k = 151$  (at least) space-time sheets associated with them, are good candidates for primitive electromagnetic life forms, in particular plasmoids identified as UFOs. Ordinary bio-matter is assumed to self-organize around these structures and nerve circuit represents a good example of a structure resulting in this manner.

Plasmoids from outer space could leak into the magnetosphere mostly through pole gaps, where the magnetic field of Earth is weak: elsewhere magneto-pause serves as a magneto-immune system,

which does not allow the penetration of the external magnetic life forms to compete about energy sources. In accordance with magneto-immune function, planetary magnetospheres are known to be self-organizing structures and the fact that Mars does not possess magnetosphere might relate to the disappearance of Martian life. Also the magnetic field of Earth is getting weaker and the change of the polarity expected to occur within two thousand years might have rather dramatic consequences for the life as we know it.

Also the magnetic life forms need energy feed to self-organize and stay awake. Plasmoids could populate magnetosphere and only wait for energy sources to self-organize. The basic metabolic mechanism would be the same as in the case of living matter [K13]. Energetic super-conducting ions must be somehow driven from the magnetic flux tubes to the atomic space-time sheets, where they collide with atoms, ionize them, and generate visible light in the atomic transitions giving thus rise to the observed luminous phenomena interpreted as UFOs (perhaps as the luminous entity “Maria” in Fatima case). The ions would eventually “drop” back to super-conducting space-time sheet and liberate the zero point kinetic energy as a quantum of metabolic energy defining what is often referred to as a universal energy currency. Essentially identical energetic cycle of Karma would be realized also in living matter but involve a complex molecular organization and many-sheeted current circuitry responsible for the control of homeostasis. For the proton the quantum is predicted to be of order .5 eV liberated also when a single molecule of ATP is used.

The realization of this primitive metabolic cycle requires the breaking of super-conductivity: some mechanism must generate join along boundaries bonds serving as bridges connecting magnetic flux tubes with atomic space-time sheets along their boundaries so that supra current leakage becomes possible. Microwave radiation could generate the required flux tubes to  $k = 151$  space-time sheets and pre-existing IR MEs could be responsible for the bridges between  $k = 151$  and atomic space-time sheets. The energies of microwave photons in the wavelength range 1-100 mm are in the range  $10^{-5} - 10^{-3}$  eV and correspond to the temperature range 1-10 K. The critical temperatures for low temperature super-conductors are in this range (note that the temperature at the magnetic flux tubes would be much lower). One can interpret this by saying that super-conductivity is not destroyed by the heating of the magnetic flux tubes but by the generation of the join along boundaries bonds with bond energy of order of the gap energy causing the leakage of the supra current to non-super-conducting space-time sheets and thus inducing dissipative effects, the dropping of protons and ions from  $k = 151$  cell membrane space-time sheet generates also microwave radiation.

This suggests that microwave photons could induce these bridges, break super-conductivity, and induce energy feed and self-organization. A similar breaking of super-conductivity might be also involved with the driving of the super-conducting ions to the  $k = 151$  space-time sheets in the living matter. Proteins could generate the needed microwave photons by coherently occurring conformational transitions. Also rotational transitions of clusters of water molecules could emit microwaves and perhaps mimic and amplify the microwaves generated by proteins. IR photons of .5 eV produced metabolically “kick” protons to atomic space-time sheets. The MEs with electrical potential difference of .5 eV define the classical correlate for this process as acceleration of proton in electric field in full consistency with the existing model of ADP-ATP process.

Plasmoids, being extremely light structures, could easily follow the energy beam flowing from the spot of tectonic activity, and the random variation of the beam direction could explain the random butterfly like motion of UFOs often observed and very difficult to understand if UFOs are structures built of steel and copper. The strange motion assigned with Sun in the case of Sun miracle can indeed be interpreted as an example of this kind of rapid random motion of plasmoid possible following microwave beam of tectonic or some other origin.

One can also imagine that plasmoids generate partially their microwave “food” themselves via the cyclotron transitions of electrons. This would require that the magnetic flux tubes in question carry a magnetic field of about .2 Tesla: the p-adic length scale in question corresponds to the thickness of the cell membrane. Solar convective zone contains magnetic fields with this strength.

## 10.4 Fatima Apparition And Microwave MEs

In the case of Fatima apparition the interaction of microwave MEs accompanied by ELF MEs would generate entanglement between the brains of people seeing the visions, plasmoid like life forms serving in the role of medium, and conscious entity “Maria”. Same mechanism applies to

UFO and ET experiences in general.

#### 10.4.1 What was the source of microwaves?

The buzzing sound heard only when Maria talked with closed lips might be understood as follows. Buzzing sound would be due to microwave hearing. Facial expression is important part of communications, especially so when one cannot speak loudly. When microwave energy feed was near the threshold of the microwave hearing, “Maria” had to use also facial expression in order to become better understood. This explanation however implies that the strength of microwave radiation was not under the control of the sender of the message or that the control was only partial.

The microwaves could correspond to the so called microwave static having biological origin and correlating strongly with taos hum: also taos hum can involve buzzing sound sensations [I6]. This microwave static appears at evening and ceases in the morning hours at definite local time. One plausible source of microwaves are transitions associated with protein conformations for which the time scale of dynamics is around 1 nanoseconds. It would be interesting to know what time of day the apparitions appeared. The occurrence of the event at 13<sup>th</sup> of every month is suggestive of both external intelligence and a biorhythm giving rise to especially intense microwave static with a period of month.

The possible biological origin of the microwave static raises the question whether the oak was the source of the microwave static. Oaks are holy trees in many ancient cultures: perhaps their ability to induce apparitions by strong microwave static could explain this partly. Some people (including me in very calm state of mind) are able to experience what might be called “a silent conscious presence” of trees. The energy scale for the rotational excitations of molecules is in the microwave region. In particular, rotational transitions of water molecules and clusters of them can generate microwave radiation effectively. Quartz crystals, piezo-electrics used both in clocks and for healing purposes, could amplify the microwaves using the energy provided by the tectonic activity. If the dominating contribution of the microwave energy is of tectonic origin, the strange motion of Sun experienced by many witnesses during Sun Miracle could correspond to the motion of a plasma ball following tectonic microwave beam. Of course, this is not the only possibility. The reported healings during apparitions suggest that microwave photons directed from the plasmoid to the brains and bodies of the witnesses were involved. If plasmoids carrying magnetic fields of order 2 Tesla for which electron cyclotron frequency is 3 GHz were involved, they could have generated these microwave photons. Also the model for crop circle formations requires plasmoids with similar magnetic field strength [H5] [K8] and light balls are frequently observed near crop formations.

The heat wave causing drying of soil and cloths could have been caused by visible and possibly also infrared light generated by the plasmoid like structure, when highly energetic super-conducting ions flowing to the atomic space-time sheets dissipated their energy by colliding with the atoms of atmosphere and by ionizing them.

#### 10.4.2 Connection with Schumann resonance

If microwave hearing involves the “dropping” of ions from  $k = 151$  space-time sheet and liberation of zero point energy as microwaves propagating along EEG MEs one could understand the connection with the Schumann resonance at 7.8 Hz in alpha band.

a) As a cavity resonance Schumann resonance prevails in entire Earth size scale, and is in TGD based model of magnetospheric sensory representations responsible for horizontal communications between different brains, and more generally, between various conscious entities. For instance, during hypnagogy alpha band dominates and could by the sharing of mental images give rise to the strange experiences in which one experiences of being another person. alpha band is also associated with creativity: perhaps our ideas are not completely ours.

b) The velocity parameter  $v$  predicted by the scaling law for  $k = 151$  (cell membrane space-time sheet) is the velocity of alpha waves at the surface of skull which suggests that alpha waves are generated in the process. For  $K^+$  and  $Cl^-$  ions cyclotron frequencies are 7.5 Hz and 8.5 Hz respectively and near to Schumann frequency and these ions are important for brain functioning: their cyclotron radiation could resonate with Schumann resonance (note that the local value of Earth’s magnetic field in brain could be subject to homeostatic control). Thus the “dropping” of

these ions from cell membrane space-time sheet could be crucial for the quantum entanglement with the conscious entity Maria.

### 10.4.3 Angel hair

The mysterious angel hair might result when ions from magnetic flux tubes flow to atomic space-time sheets. Perhaps the process creates chemical compounds in molten state which then cool and solidify. Hair like appearance might reflect the geometry of magnetic flux tubes (whose thickness is about 2.5-5 micrometers for Earth's magnetic field). Many crop formations are known to contain magnetized iron [H5] as well as small glass balls consisting of  $\text{SiO}_2$ , that is quartz [H3]. Meteoric iron could come from the ionosphere along magnetic flux tubes. Si ions or quartz could flow along magnetic flux tubes from the spot of the tectonic activity to the plasmoid, and become heated to high temperature when entering to atomic space-time sheets and colliding with oxygen atoms of the atmosphere. This in turn would give rise to glass balls. An analogous mechanism might be give rise to angel hair.

### 10.4.4 Were the “vehicles” real?

There is some anecdotal evidence suggesting that UFOs are more than mere plasma balls, and this kind of objects might have been involved also with the Marian apparition. Many-sheeted space-time concept predicts a mechanism leading to the reduction of inertial and gravitational masses of spinning magnetic systems [K36]. These objects are predicted to be accompanied by plasma. There is laboratory evidence for this kind of phenomenon [H6]. Hence some UFOs could be space crafts possessing almost vanishing gravitational and inertial masses and the vehicles observed by witnesses in the case of Marian apparition could be also genuine space crafts of this kind.

### 10.4.5 Healing phenomena and apparitions

Healings and water with special healing properties are also associated with Marian apparitions [H1]. Microwave hypothesis provides understanding also about this aspect, and somewhat unexpectedly, about the mechanism of homeopathic healing.

In [K12] it was proposed that the clusters of water molecules forming liquid crystals can mimic the rotational spectrum of various molecules, and that the ability to reproduce the rotational frequency spectrum of the medicine molecule is an essential element of homeopathic healing. The level of self-organization of water would thus be measured by how complex mimicry it is able to perform.

Why rotational microwave energy spectrum is so important for healing, can be understood as follows. The many-sheeted current circuitry, involving atomic space-time sheets and magnetic flux tubes and also other space-time sheets, is extremely complex control structure [K21, K20]. The continual regeneration of bridges between say atomic space-time sheets and magnetic flux tubes by microwaves emitted by proteins is necessary to sustain this circuitry. An important category of diseases is due to the failure to generate the bridges between super-conducting and atomic space-time sheets so that this control circuitry suffers shortcuts. Perhaps the genetic expression of some proteins responsible for the microwaves generating particular bridges fails. The medicine or its homeopathic counterpart would help to generate (or even re-establish the generation of) the microwave spectrum responsible for the generation of the lacking bridges in the circuitry.

This would allow to understand why spring water with special healing properties seems to be a correlate of apparition places [H1]. Just like the homeopathic remedy, the spring water would mimic the rotational energy spectrum of some medicine molecules and would induce the same healing effects (I am grateful for A. Brodziak for emphasizing the importance of the homeopathic aspect).

In present case the healing would require the feed of microwave energy to the healed. It could be the energy is transferred via the mediation of the self-organizing plasmoidic life form and has tectonic origin.

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