Magnetic Bubbles in TGD Universe: part II

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Abstract

Solar flares involving mass eruptions accompany sunspots and the reversal of the magnetic polarity of the solar magnetic field. The models however have several problems. For instance, it is believed that reconnections of magnetic field lines are essential for the process but the prediction for the rate of the process is by 13-14 orders of magnitude too low. The TGD view of space-time provides a new view of electromagnetic fields based on the notion of a field body. Dark matter as phases of ordinary matter with a large value of effective Planck constant is the second new idea and zero energy ontology (ZEO) provides a third new ingredient.

The recent advances in the understanding of the formation of astrophysical structures in various scales in the TGD framework inspire the attempt to understand the structure of the solar magnetic field and its dynamics involving solar cycle, solar flares, reconnections and reversal of the solar magnetic field. By fractality, the general vision leads to a concrete model for the solar cycle and strongly suggests a concrete analogy of the solar cycle with the basic rhythms appearing in biological systems and the identification of the counterparts of anabolism and catabolism at the fundamental level.

The general picture also leads to a model for the reversals of the Earth's magnetic field and to interesting speculations concerning their connection with the evolutionary leaps. In zero energy ontology, the reversal involves the decay and re-organization of the magnetic body in zero energy ontology. The decay is analogous to the decay of the biological body after death and induces it. This interpretation provides an understanding of the so-called Tukdam phenomenon.

Contents

1 Introduction

The finding that motivated these comments was the finding of what was so-called solar heartbeat [E3] (`https://rb.gy/7gaa78`). Two kinds of quasiperiodic pulsations (QPPs) with periodicities 10-20 s and 30-60 s of microwave emissions during solar flares. These periods are correlated and probably have the same underlying reason. A kind of solar heartbeat is in question. It might be assignable with the reconnection process for the solar magnetic field. The notion of magnetic reconnection is however poorly understood in the standard physics framework: the estimates for the reconnection rate are by 13-15 orders of magnitude too small.

The TGD framework leads to a new view of space-time as a 4-D surface in $H = M^4 \times CP_2$ and also of electromagnetic and other fields. In particular, fields are replaced by topological field quanta identifiable as space-time quanta. One ends up with the notion of a field body, in particular that of a magnetic body (MB) consisting of monopole flux tubes not possible in Maxwell's electrodynamics and flux tubes with boundaries serving as counterparts of Maxwellian magnetic fields.

Could periodic reconnections of closed flux tubes with the shape of a very flat square caused by the transverse oscillations of the flux tubes occurring during solar flares induce the periodic reconnections of flux tubes? Microwave frequencies for dark charged matter at the flux tubes could be due to cyclotron transitions.

What could be the origin of the periodicities of transversal oscillations? I have earlier discussed [L3] the 26 second rhythm of Earth [L3] analogous to alpha rhythm. Intriguingly, this period is between the mentioned periods. Could the Earth's alpha rhythm and solar heartbeat relate to each other? This might be considered in the TGD framework if the rhythms are associated with gravitational monopole flux tubes emerging from the Sun and connecting the gravitational magnetic bodies of Earth and Sun to a single quantum coherent entity.

This finding inspired the attempt to understand solar flares in the TGD framework.

1.1 Basic problems of the existing models of solar flares

The models for the solar flares (`https://rb.gy/yw5jpd`) have several problems.

1. The source of the flare's energy is believed to be magnetic but what is the basic mechanism? How the magnetic energy is transformed to the kinetic energy of particles? How accelerations to energies in GeV range and beyond are possible? In the standard framework extreme accelerations would be required.

2. Reconnection of magnetic field lines is believed to be the basic mechanism but the predicted rate of reconnections is by 13-14 orders of magnitude too small. There might be something fundamentally wrong with the notion of reconnection.

3. There are also inconsistencies regarding the total number of accelerated particles. Sometimes this number is larger than the total number in the coronal loop. Where could the additional particles come from?

4. It is not possible to forecast flares.

1.2 The notion of reconnection is questionable

The Maxwellian notion of reconnection can be challenged. Field lines rather than flux tubes which reconnect. Note however that the notion of flux tubes is used in the phenomenology of MHD.

The rate of reconnections based on the Maxwellian picture assumes that the reconnection rate is proportional to the electric field associated with the separatrix at which the reconnection of field lines occurs. The actual reconnection rate for solar flares is by 13-14 orders higher than predicted so that something is badly wrong. The fact that conductivity can vary in huge limits suggests that charges for which conductivity is very high or even superconducting matter might be present.

Could the TGD view of reconnection help? Monopole flux tubes or flux tubes with boundaries as counterparts of Maxwellian magnetic fields carrying currents as dark matter in the TGD sense might provide a more realistic approach and the rate of connection could be estimated from classical dynamics for preferred extremals.

1.3 Is the Maxwellian view of currents and plasma correct?

When the conductivity of charge carriers is effectively infinite, Maxwellian MHD currents are frozen to flux lines. In the TGD framework, the Maxwellian flux tubes having boundaries could carry ordinary ohmic currents. Could dark particles at monopole flux tubes flow like supra current with vanishing resistance? At least these currents could correspond to currents frozen to field lines.

The absence of dissipation for the dark matter at the monopole flux tubes could explain the presence of ultra-energetic particles and the strange finding that solar flare can involve more particles than contained by the flare. The reconnection process gives rise to a pair of U-shaped flux tubes, which are highly curved. Could the dark particles leak out from the flux tubes in the reconnection process and transform to ordinary particles. There would be no gigantic acceleration since the dark particles would already have very high energies.

What about the TGD counterpart of plasma? Does the plasma correspond to the ordinary electrons at flux tubes with boundary or to the dark electrons at the gravitational monopole flux tubes? A possible TGD view of quark gluon plasma [L16] is that sea partons reside at the MB of hadrons and are dark in the TGD sense. Could the dark current carriers be analogous to sea partons? Could ordinary charge carriers with ohmic resistance serve as the analogs of valence quarks?

The answers to these questions requires a TGD based formulation of the basic concepts of plasma physics and magnetohydrodynamics (MHD) of the Sun.

1. MHD (`https://rb.gy/kv09cj`) and plasma physics (`https://rb.gy/g6wxyl`) must be reconsidered in [L9] in terms of the TGD based view of electromagnetic fields.

2. The new geometric view of magnetic fields forces a reconsideration of the notions of solar magnetic field and related notion of Parker spiral, coronal loops `https://rb.gy/gedbk2`), current sheets (`https://rb.gy/8yw1r8`) and `https://rb.gy/n0cyoe`).

3. The dynamics of the solar magnetic field involves several notions, which must be reformulated in the TGD framework. Sunspot cycle (`https://rb.gy/cvu4av`) and `https://rb.gy/rigawy`) must be understood in the TGD framework. Solar activity is maximum is assignable to the polar reversal of the solar magnetic field. There are many poorly understood phenomena related to the polar reversal such as solar flares (`https://rb.gy/yw5jpd`) and magnetic reconnections (`https://rb.gy/sbktub`) about which TGD could provide insights. Magnetic reconnection is an especially poorly understood notion: in the standard model the rate for their formation is 13-14 orders of magnitude too low.

The recent advances in the TGD based understanding of the formation of astrophysical structures in various scales [**?**] lead to a general vision, which inspires the attempt to understand the structure of the solar magnetic field and its dynamics involving solar cycle, solar flares, reconnections and reversal of the solar magnetic field. By fractality, the general vision leads to a concrete model for the solar cycle and strongly suggests a concrete analogy of the solar cycle with the basic rhythms appearing in biological systems and the identification of the counterparts of anabolism and catabolism at the fundamental level.

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2 A TGD inspired model for solar flares

In the sequel a TGD based view of the reversal of the solar magnetic field is discussed. Besides the new view of space-time and electromagnetic fields, the proposal involves in a crucial manner zero energy ontology (ZEO) [L4, L18, L15].

2.1 The motivating finding

The finding that motivated these comments was the finding of what was called solar heartbeat [E3] (`https://rb.gy/7gaa78`). Two kinds of quasiperiodic pulsations (QPPs) with periodicities 10-20 s and 30-60 s of microwave emissions during solar flares. These periods are correlated and probably have the same underlying reason. A kind of solar heartbeat is in question. It might be assignable with the reconnection process for the solar magnetic field. The notion of magnetic reconnection is however poorly understood in the standard physics framework: the estimates for the reconnection rate are by 13-15 orders of magnitude too small.

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2.3 A TGD based view of the polarity reversal of the solar magnetic field

In the sequel a TGD based view of the reversal of the solar magnetic field is discussed. Besides the new view of space-time and electromagnetic fields, the proposal involves in a crucial manner zero energy ontology (ZEO) [L4, L18, L15].

2.3.1 TGD counterpart of the Maxwellian magnetic field

Flux tubes carrying magnetic fields replace the flux lines of the Maxwellian theory. TGD predicts two kinds of flux tubes: monopole flux tubes with closed cross section and Maxwellian flux tubes with boundary. There is an analogy with the fields H and M of Maxwell's theory.

The Maxwellian part of the magnetic field could correspond to magnetization M having as the TGD counterpart flux tubes with boundary carrying currents generating the fields in the interior of the flux tube. The field H of Maxwell's theory could correspond to monopole flux tubes and could induce magnetization M as Maxwellian part of the magnetic field. Monopole flux tubes and Maxwellian flux tubes could correspond to parallel space-time sheets.

The monopole flux part of the magnetic field differs in several respects from the Maxwellian part.

1. The magnetic fields at monopole flux tubes require no current to maintain the magnetic field. The presence of monopole flux tubes allows us to understand the existence of magnetic fields in cosmic scales and also the maintenance of the magnetic field of Earth [L1].

2. Monopole flux tubes would carry charged dark matter characterized by effective Planck constant $h_{eff} = nh_0$. Especially interesting flux tubes are gravitational flux tubes with gravitational Planck constant $\hbar_{eff} = \hbar_{gr} = GMm/\beta_0$, where $\beta_0 = v_0/c < 1$ is velocity parameter, and M is large mass of say Sun or Earth and m corresponds to small mass such as electron mass. This notion was introduced first by Nottale [E2].

   The freezing of the charge carriers to the flux lines would have a concrete interpretation. The freezing could occur also for the Maxwellian flux tubes and charge carriers would be at the boundaries of the flux tubes. The large value of h_{eff} implies large scale quantum coherence and the monopole flux part of the MB would naturally serve as a "boss" controlling the dynamics at the lower levels of hierarchy. This motivates the interpretation as counterpart for the field H.

3. Maxwellian parts of the magnetic fields could be generated by currents at the boundaries of the flux tubes if conductivity is very large. The flux tubes would be analogous to current wires. Magnetization M could correspond to the flux tubes with boundary, which carry the currents inducing the magnetic field in the interior. Magnetization would occur for the charged particles at the boundaries of these flux tubes.

4. The thickening of dark flux tubes is a phase transition liberating magnetic and volume energy and also dark matter if part of it transforms to ordinary matter in the process. Extreme accelerations would not be required since the dark particles forming quantum coherent phases at the flux tubes would have very high energies due to the very low dissipation. This could explain the huge production of energy and anomalously high particle energies.

5. For the topological counterpart of the reconnection process, field lines are replaced by flux tubes. When a closed flux tube has the shape of a very narrow rectangle, it is critical against reconnection, which could involve the chance of h_{eff}. The dark charge carriers leaked out of the flux tubes would have the ordinary value $h_{eff} = h$ of the effective Planck constant.

2.3.2 A model for the reconnection

There was an interesting article in Quanta Magazine about the reconnections of the magnetic fields for astrophysical objects (`rb.gy/npoc0`). Two kinds of reconnections have been observed. The slow ones for which the Maxwellian electrodynamics provides a satisfactory description and the fast ones, which are not understood.

Fast reconnections liberate magnetic energy powering solar flares and solar wind, high-energy particles ejected by exploding stars, and the glow of jets from black holes. The popular article told about a theory of Yi-Shin Liu et al (`rebrand.ly/6uv3jb3`) claimed to allow the understanding of the fast reconnections in the Maxwellian framework. The model assumes that reconnection is induced by a generation of electric fields for instance by different velocities of protons and electrons moving along the flux lines.

Personally I am a little bit skeptical. There are many other enigmas related to magnetic fields in cosmic scales. Particular, the existence and stability of magnetic fields in astrophysical scales is a mystery in the Maxwellian framework. Also these problems should be solved.

In the TGD Universe, the flux lines are replaced with flux tubes which can be seen as bundles of flux lines assignable to 3-D surfaces in $M^4_2 having 4-D space-time surfaces as orbits. Reconnection of flux lines is rep$ $space as 3-surfaces othat topological reactions for 3-surfaces are in question : this conforms with "Topological Geo$

Intriguingly, TGD allows two kinds of flux tubes.

1. Flux tubes with a disk as cross section and having a boundary correspond to the Maxwellian situation. Cross section can be also closed but if the flux vanishes, the flux tube is not stable against splitting.

   The Maxwellian flux tubes with open cross section require currents to create the magnetic field. Currents tend however to dissipate so that the Maxwellian flux tubes and corresponding magnetic fields are not stable. This leads to a problem in understanding why magnetic fields in astrophysical scales are so stable.

2. The monopole flux tubes which have closed 2-surface (say) spheres as a cross section are not possible in Minkowski space and carry conserved monopole fluxes.

Monopole flux tube have several properties which make them very attractive, not only astrophysically and biologically but in all scales, for instance from the perspective of particle physics.

1. Monopole flux tubes are stable against splitting. U-shaped monopole flux tubes can however split by reconnection which means emission of a closed flux tube. This occurs for instance in solar wind at the night-side of the Earth.

2. Monopole flux tubes form tube networks having physical objects in various scales as nodes. They occur in all scales, including astrophysical and biological scales.

3. The tell-tale signature of the monopole flux fields is that no current is needed to create them. Monopole flux tubes explain the existence of magnetic fields in cosmic scales which would not have been even created since the currents needed to create them are random.

   For instance, Earth's magnetic field is the sum of these two contributions and monopole flux is estimated to be 2/5 of the entire flux. Monopole contribution would be stable and explain why the Earth's magnetic field has not decayed long ago. The monopole part of the Earth's magnetic field plays a key role in TGD inspired quantum biology based on the notion of dark matter as phases of ordinary matter with an effective Planck constant residing at the magnetic body of the system.

4. Monopole flux tubes are the key building bricks of all astrophysical structures in the TGD Universe, in particular solar magnetic fields, and are actually directly visible. Dark matter and energy would be associated with cosmic strings (not those of gauge theories), which have 2-D string world sheet as cross section and 2-D complex manifold of CP_2, $says phere, as a CP_2 projection. They c$

The reconnections of the monopole flux tubes would be natural candidates for a fast reconnection for which the Maxwellian model was proposed. Do the TGD view and the Maxwellian view exclude each other or could they be parts of the same story?

The reconnection of a U-shaped flux tube for which parallel portions carry opposite currents requires a pinch of the flux tube so that flux tube portions can touch each other. Ampere's law states that current wires carrying parallel currents attract each other. Could it explain the pinch? One can imagine two mechanisms.

1. The current along the U-shaped flux tube is conserved unless there is a temporary accumulation of electric charge. The absence of charge accumulation implies that the net currents along parallel portions are opposite and repel each other. However, if charge accumulation takes place, the currents can become locally parallel and this could cause the attraction and pinch. The interesting question is what could cause the local charge accumulation.

2. One can also consider a geometric mechanism in which the second portion of the U-shaped flux tubes turns temporarily backwards and the portion in which current runs parallel to the current in the unaffected portion comes near to it so that an attractive force causing the pinch is generated and U-shaped flux tube pair emits a closed flux tube.

3. In the TGD framework, quantum tunneling in macroscopic length scales as a pair of "big" state function reductions (BSFRs) reversing the arrow of time temporarily is suggestive. Suppose that in the initial situation there are two U-shaped flux tubes associated with the two molecules and currents are steady and conserved except during the reconnection period.

   Reconnection of the two U-shaped flux loops would give rise to a pair of monopole flux tubes of opposite magnetic fluxes connecting the two objects, say biomolecules. In this conformation parallel currents flow along the flux tubes. It is assume that the charges at the different flux tubes form Cooper pairs.

   Supra current induces an accumulation of net charges of opposite sign at the ends of the flux tube pair. Supra current cannot however flow forever. Charge saturation occurs and the supra current goes to zero. In this situation reconnection back to U-shaped flux loops can take place. This state is not superconducting since individual charges at the flux tubes flow in opposite directions and cannot form Cooper pairs. Therefore the splitting of Cooper pairs and reconnection would occur simultaneously. BSFR would correspond to a phase transition between super-conducting and non-superconducting states. This phase transition would be a basic mechanism of bio-catalysis.

2.3.3 TGD based model for the solar magnetic field

What can one guess about the structure of the MB consisting of monopole flux tubes (and possibly also sheets)?

1. Only the Maxwellian magnetic field at QFT limit obtained by replacing many-sheeted space-time with a slightly curved Einsteinian space-time surface with 4-D M^4 is directly accessible to the experiments. These fields are known only in the region outside the solar surface. This leaves a lot of freedom.

   A guideline comes from the notion of magnetic bubble [L17] playing a key role in the TGD inspired model for the formation of astrophysical structures as explosive processes. Magnetic bubbles consist of monopole flux tubes at a 2-D surface, such as a sphere. By fractality, one expects that the model should work also in the case of solar flares, which also involve explosions.

2. The magnetic bubble with $\hbar_{eff} = \hbar_{gr}$ a spaghetti of monopole flux tubes with a shape of 2-D closed surface. It would be emitted in an explosive process liberating dark matter and energy. Dark matter would be transformed to ordinary matter and liberate energy.

   A good guess is that the solar surface carries this kind of spherical layer consisting of closed monopole flux loops. The inner parts of monopole flux loops would be along the solar surface and fixed with it. The outer parts of the flux loops would extend to outer space and bound the shape of a moon crescent. This shape would be an outcome of centrifugal force which would be compensated by the force due to string tension.

3. The rotation of the outer parts of the flux tubes is not rigid body motion with a constant angular velocity. The motion is slower than rigid body rotation and this gives rise to a differential rotation in which the angular velocity at the equator is smallest. This affects the shape of the flux tube so that it becomes spiral-like. The lag is largest at the equator.

   String tension of the flux tube opposes this motion and eventually the situation becomes critical for the reconnections when the flux tube portions carrying opposite fluxes and located near the equator are close enough. This reconnection process is associated with the formation of solar spots. This leads to a transformation of the outer part of the flux tube so that it becomes parallel to the solar surface.

   By freezing, the spiral structure for the current sheet should conform with the structure of the magnetic field in the Maxwellian picture obtained at the QFT limit. In TGD, the

assumption that currents flow along monopole flux tubes implies this if the Maxwellian flux tubes are parallel to the monopole flux tubes. In this case the freezing would occur for the entire magnetic field.

2.3.4 A general view of the solar flare as a reconnection process

1. In TGD the reconnection is replaced with a topological reconnection for monopole flux tubes and their Maxwellian counterparts.

2. Reconnection at the equatorial current sheet eventually occurs for twisted flux tubes and the outer part of the flux tube decays by emitting small flux loops. Solar flares would accompany this process. Huge magnetic and volume energies could be liberated if the flux tubes are thickened in the phase transition. Twisted flux loops are transformed by the emission of loops to non-twisted dipole loops with strands parallel to the solar surface.

   In this process charged dark particles with very high energies leak out from the flux tubes. No acceleration mechanism is needed. This mechanism could also explain cosmic rays with ultrahigh energies without a need for acceleration mechanisms. Monopole flux tubes can also carry electric fields parallel to them and this could accelerate the charged particles to very high energies since dissipation is absent or very small due to the large value of $\hbar_{gr}$.

3. This picture allows us to also understand the presence of the current sheet. It would be associated with the Maxwellian part of the magnetic field at equator where the fluxes of neighboring portions of the flux tube are opposite and reconnections occur.

   The Maxwellian flux tubes could be parallel to the monopole flux tubes and the current sheet would be associated with them if Maxwell's equations hold true approximately as they would at the QFT limit of the TGD. This limit is obtained by replacing the sheets of the many-sheeted space-time with single metrically deformed region of M^4 such that gravitational field *resp.* gauge potentials are identified as sums of deviations of induce metric from M^4 metric *resp.* induce gauge potentials.

2.3.5 How the reconnection process could lead to a reversal of the polarity

How the reconnection process could lead to the reversal of the polarity.

1. The flip of the polarity of the solar magnetic field occurs when the activity of the Sun is maximum. The direction of the magnetic flux at the long rectangular monopole flux tubes must change.

   Conserved monopole flux however prevents this. One option is that the rectangular flux tube rotates along its axis by π and permutes inner and outer parts of the flux tube. This cannot be excluded but does not seem plausible since the inner part of the flux tube is fixed.

   The second option is that the closed flux tubes split by a reconnection process into pieces and the short flux loops should flip and by reconnections fuse back to long flux loops with an opposite direction of magnetic flux.

2. The question how the monopole flux tubes carrying opposite fluxes could be generated from the short flux tubes produced by the decay process, looks very difficult to answer in the framework of standard quantum physics. Second law forbids this process.

   Could zero energy ontology (ZEO) come to rescue? In ZEO both arrows of time are possible and the arrow of time is changed in ordinary ("big) state function reduction (BSFR) [L4, L18, L15].

   One has quantum gravitational coherence at the level of gravitational flux tubes. Could BSFR and therefore a time reversal take place at the level of gravitational MB? Could the reconnection of small loops to a long loop in the opposite direction of time somehow correspond to a decay process with a reversed thermodynamic arrow of time. Note that the change of the thermodynamic arrow of time should not be confused with time reflection T as a geometric symmetry.

3. What happens to the magnetic field B when the thermodynamic arrow of time changes? The Maxwellian part of B changes its sign since it is a curl of vector potential A, having as its source the 3-D current j, which behaves like velocity and changes its sign.

   The monopole flux part of B does *not* have j as source and for string-like objects $X^2 \times Y^2 \subset M^4 \times CP_2$ monopole flux changes sign only if the change of the thermodynamic arrow of time involves a complex conjugation in CP_2. It seems that also the induced electric field associated with the deformation of a string-like object changes its sign too in complex conjugation. This means that the charges change sign and therefore also currents. Nothing would happen to B.

   If no complex conjugation occurs for CP_2, monopole fluxes are not affected. However, the minimization of the magnetic interaction energy between long Maxwellian flux loops and short monopole flux loops could force the monopole flux loops to flip. The roles of H and M in the magnetization would be permuted: M would change the direction of H.

4. Could Lazarus effect have an interpretation as a BSFR so that no new CD would be generated? The consistency with the earlier view would require that the arrow of time changes in BSFR but that the moment of the geometric time identified as a correlate of subjective time assigned with the decay process corresponds to the M^4 time coordinate for the intersection of the half-cones. If the sub-CDs of CD located in either half-cone of CD co-move with it in its expansion by discrete scalings so that the M^4 time associated with their mid points flows, this picture is consistent with that discussed in [L18, L15].

   Or could Lazarus effect mean a creation of a new CD as an embedding space correlate for a perceptive field of a conscious entity, self [L19, L15]? Ordinary birth could serve as an example of a generation of a new CD.

In the ZEO based interpretation as a BSFR, the interpretation of this process would be as an analog of biological death followed by reincarnation with an opposite arrow of time.

1. In ZEO, the monopole flux tube pair, which has split into short segments, would be the "corpse" of both the previous gravitational MB and the new MB with an opposite arrow of time. The corpse could be seen as the outcome of two aging processes proceeding with opposite arrows of time from geometric future and past and meeting at the moment of the reconnection process, which corresponds to quantum criticality.

2. The outsider would see the death and decay process of the gravitational MB and its miraculous reincarnation to MB with opposite magnetic fluxes. This "Lazarus effect" would be something new as compared to the earlier applications of ZEO. The sunspot cycle could be perhaps seen as an analog of the sleep-wakeup cycle.

3. This picture is very general and living matter provides especially interesting applications since the decay process for the monopole magnetic flux tubes in biological death should induce the decay process of the biochemical structures. Metabolism has two sides: anabolism is the generation of organic molecules carrying metabolic energy taking place in photosynthesis and in the reconstruction of organic molecules from simpler building bricks produced by catabolism liberating metabolic energy and occurring in digestion. Could the anabolism and catabolism be time reversals of each other and reduce to catabolism of monopole flux loops with opposite arrows of thermodynamic time?

3 Possible applications to the polarity reversal of Earth's magnetic field and to biology

The proposed picture might apply also to the model for the flip of the Earth's magnetic field discussed in [L1]? Magnetic poles wander and this could be understood as a rigid body motion of MB. The polarity flip takes place rather rapidly and could occur BSFR and involve the magnetic catabolism and anabolism of the monopole flux loops. Since the monopole magnetic fields play

a central role in the TGD inspired quantum biology, the possible disastrous consequences of this transition challenge the TGD inspired quantum biology.

3.1 Do the reversals of the Earth's magnetic field induce evolutionary leaps?

I received from Zakaria Ameziane a highly interesting question related to the TGD inspired theory of consciousness and quantum biology, in particular self hierarchy and the notion of quantum jump according to TGD, and the role of the Earth's magnetic field in quantum biology. The question went roughly as follows.

"There is an interesting hypothesis which demonstrates that the DMT, by its affinity with UV-B rays, could be produced significantly, endogenously when the electromagnetic fields are reversed. If this hypothesis would prove to be true, could it trigger a new quantum jump?"

The question involve a link to a discussion in DMT Quest discussion group (DMT Quest is an organization, which supports DMT research) in Twitter (`https://rb.gy/sijxt9`). The link is warmly recommended. The discussion was related to the the so-called Stoned Ape Theory of evolution claims that that the transition from Homo erectus to Homo sapiens and the cognitive revolution was caused by the addition of psilocybin mushrooms, specifically the mushroom Psilocybe cubensis, into the human diet around 100,000 years ago. One can also consider alternative forms of this idea.

From the discussion one can pick up the following facts.

1. DMT is often assigned with pineal gland, "third eye" and the seat of the soul, according to Descartes but according to recent views it is present in the entire brain (see ¡A HREF="https://rb.gy/yftalo"¿this¡/A¿). DMT (I have discussed DMT from the TGD point of view in [L2, L7]) is reported to induce a growth of neurons (`https://rb.gy/zx7zsh`).

   By its affinity with UV-B rays, DMT could be produced significantly endogenously as magnetic field reversal occurs and the shield provided by the Earth's magnetic field against UV rays is temporarily lost.

2. The latest magnetic reversal occurred 40,000 years ago in the so-called Laschamp event (`https://rb.gy/i35kqa`). Interestingly, Neanderthals disappeared at this time.

3. 40,000 years also corresponds to a time when a large change in the shape of human brain took place [J1] (`https://rb.gy/hcg8ii`). The following excerpt is from the abstract of the article.

   ".... Our data show that, 300,000 years ago, brain size in early H. sapiens already fell within the range of present-day humans.

   Brain shape, however, evolved gradually within the H. sapiens lineage, reaching present-day human variation between about 100,000 and 35,000 years ago. This process started only after other key features of craniofacial morphology appeared modern and paralleled the emergence of behavioral modernity as seen from the archeological record.

   Our findings are consistent with important genetic changes affecting early brain development within the H. sapiens lineage since the origin of the species and before the transition to the Later Stone Age and the Upper Paleolithic that mark full behavioral modernity."

4. Relatively recent research indicates that changes in the geomagnetic field of the earth causes genetic and metabolic changes in plants indicating the potential to be a driver of evolution [I1] (`https://rb.gy/mxhq2z`).

These observations inspire the question whether the magnetic reversal could have induced not only a significant growth of neurons in human brains but also an evolutionary jump?

1. Could this effect have occurred at the level of genes, at the level of epigenesis or both? The amazing findings of Levin [I3, I4, I5, I2], discussed from the TGD point of view in [L19], suggest that besides genes, also electromagnetic field patterns assignable to cell groups (not only neuron groups), determine the outcome of morphogenesis via epigenesis and that

modifications of these patterns during the embryo stage can dramatically modify the outcome of morphogenesis without any change at the level of genes. What is remarkable is that these changes are inherited.

2. Could the magnetic reversal have induced an inheritable change of the shape and the electromagnetic structure of the brains of developing embryos? Could the increased amount of DMT during the reversal be behind this change? If only a permanent epigenetic change is in question, it might be induced by DMT.

The following summarizes roughly my reply to the question by Zakaria Ameziane. The reply describes first very briefly what self hierarchy and quantum jumps mean inthe TGD framework.

1. Selves can fuse to larger selves by entangling stably. This could occur in both "small" and "big" statefunction reductions (SFRs). In a pair of BSFRs (BSFRs change the arrow of time) and a TGD counterpart of quantum tunnelling takes place this kind of fusion could occur. This would mean an extension of consciousness. Perhaps this happens as the person gradually wakes up. Also the fusion of say visual fields to single visual field could occur in this way. Right and left brain, or rather their magnetic bodies, could also fuse in this way.

2. DMT is assigned with pineal gland, I would tend to see its presence as a prerequisite for a connection to a rather high level of hierarchy of selves, magnetic body corresponding to a rather long length and time scales.

Concerning the finding that something dramatic took place in the evolution of the human brain about 40,000 years ago when also magnetic reversal took place. Catastrophes induce quantum criticality in long scales which in turn could induce evolutionary jumps.

1. I have just developed a model for the change of the magnetic polarity [L17]: the change of the polarity would be associated both in the case of Sun and Earth to a BSFR changing the arrow of time. This process would be like death followed by reincarnation with the opposite arrow of time at the level of the magnetic body (MB). The sequences of reversals would define the analog of a sleep-wakeup cycle on a large scale.

2. BSFR corresponds to quantum criticality: the monopole flux loops of the magnetic body of Earth decay into pieces, change direction and fuse again as required by the magnetic reversal. MB is the boss and this universal mechanism would also induce biological decay after death and re-organization of molecules to a living organism. It would also be behind catabolism and anabolism at molecular level.

3. During the period of BSFR associated with the reversal, the UV radiation from outer space can enter the Earth's surface and induce large genetic and also other kinds of biological changes. A BSFR at the level of MB of Earth inducing the magnetic reversal could have induced a cascade of BSFRs at shorter scales possibly inducing dramatic evolutionary changes.

   In the TGD Universe, the genes do not dictate everything. Also electromagnetic field patterns at the cellular level, both for neurons and ordinary cells, are in a central role in dictating the development of embryos, as Levin's findings demonstrate. Their change would involve epigenetic change [L19]. This point was already discussed.

4. For instance, these BSFRS inducing large changes at the MB of the brain could have increased the probability of the fusion of MBs of say left and right hemispheres to a larger unit, the MB of the entire brain. This would have induced a stronger interaction of right and left hemispheres. The period of time in an entangled, "whole-brainy" state would have significantly increased.

   This might relate to the hypothesis that bicamerality in which right and left hemispheres behaved like independent selves (schizophrenics and young children might be bicamerals) transformed to modern consciousness in which the brain hemisphere tends to behave like a single coherent entity.

5. There is evidence that the magnetic field of Earth is changing right now (`https://rb.gy/penzen`). Could this mean that polarity reversal of the Earth's magnetic field might happen in the not so distant future. An interesting question is what this could mean for our species.

6. The magnetic bodies of Sun and Earth interact and in TGD framework both MBs play a key role in the quantum biology [L14, L13] based on gravitational quantum coherence prevailing in astrophysical scales.

   An interesting question is whether the solar 11+11 year "sleep-awake" cycle of the solar MB could induce periodicies in human behavior, say in social structures. Maybe statisticians could have something to say about this.

3.2 Tukdam and TGD

The following considerations were inspired by a TV document (`https://rb.gy/abt8za`) about a strange phenomenon known as Tukdam. What happens is that in Tukdam state the person is physically dead but is believed to be in a continued meditation. There is no EEG, the heart does not beat, and there is no normal metabolism. What is strange is that the decomposition processes do not start. The condition can last up to a couple of weeks. Similar longer-lasting ones have been reported: a yogi can be buried underground for months in an oxygen-free state and then wake up.

Tukdam phenomenon challenges neuroscience's view of the brain as the seat of consciousness. According to reports there could be awareness and a sensory experience consisting of different light sensations. The Tibetan Book of the Dead describes these experiences. Near-death experiences have many similar features.

In the body in Tukdam, the area of the heart is reported to feel warmer to the touch than the rest of the body, but the thermometer does not detect this difference. This would indicate that the body receives metabolic energy at the cellular level from some other source than in the normal metabolism, and that living matter can detect what measuring devices based on the recent knowledge provided by modern physics cannot detect.

Where could this energy come from? If one wants to answer this, one must also ask what happens in death and what is consciousness and what is life.

1. Dark energy and matter are the two basic puzzles of recent day physics. In the TGD approach, dark matter is identified as phases of ordinary matter, for which the effective Planck constant h_{eff} is much larger than normally. In particular, the Planck constant $h_{eff} = h_{br}$ characterizing gravitational flux tubes can be very large and makes quantum coherence possible even on astrophysical scales. Large Planck constants would be associated with the dark matter magnetic body, which would be the TGD counterpart to the magnetic field of Maxwell's theory, but would differ from it in many respects. As a quantum coherent unit, this magnetic body would control the ordinary biological body and induce its coherence. The classical energy of a magnetic body, consisting of volume energy and magnetic energy, would be dark energy.

2. In the TGD Universe dominated by zero energy ontology, consciousness is a universal phenomenon and present on all scales, from elementary particles to the level of the cosmos. Even galaxies, stars and planets would be conscious beings. Also life and death would be universal phenomena. Likewise, the biological decomposition process associated with death would correspond to the universal decomposition process, which would essentially correspond to the decomposition of magnetic monopole flux tubes (magnetic catabolism), which would induce the catabolism of the breakdown of biomolecules. Its time-reversed version would be magnetic anabolism and induce the building of bio-structures such as molecules.

3. The reversal of the Sun's magnetic field would correspond to magnetic catabolism as the breakdown of long monopole flux tubes into very short parts. It would be followed by magnetic anabolism as their re-fusion into long flux tubes. The solar cycle would correspond to the sleep-wake cycle, or more precisely: a series of lives in different directions of time. Death would only be a change of time's arrow, nothing final.

4. The fundamental metabolic processes would be basically magnetic anabolism and catabolism induced by "big" state function reductions changing the arrow of time and inducing the

biological anabolism and catabolism. Death would mean reincarnation with the opposite arrow of time.

In Tukdam, the biological body would be dead, but the magnetic body would still be alive and prevent the biological decay from starting. The disintegration of the magnetic body as a reconnection process splitting monopole flux tubes to pieces in the way described above would start in Tukdam much later than normally, and initiate the disintegration of the biological body. The contents of the conscious experience in Tukdam, light sensations and deep peace, would come from the magnetic body. The dead biological body would not provide contribution from sensory input, motor activity, and cognition.

4 Summary and outlook

This article was inspired by a single puzzling astrophysical observation but was extended by further similar observations. The discussion of these findings allowed us to develop a TGD based vision about the generation of astrophysical structures to a much more detailed level. This vision should apply also to other interactions.

The foregoing discussion suggests that the dynamics of gravitational fields could reduce to the dynamics of flux tubes subject to the conservation of total Kähler electric fluxes, which have a definite sign.

The topological dynamics would be essentially re-organization of the network formed by electric flux quanta as nodes of the network connected to each other by flux tubes, which can also carry Kähler electric flux. Twistor lift of TGD and $M^8 - H$ duality [L5, L6] led to a rather similar picture for the scattering amplitudes [L11, L12] in terms of fundamental fermions.

This generalizes also to the dynamics of gauge fields. Flux tubes can be characterized by the value of h_{eff} characterizing a given interaction, and the notion of gravitational Planck constant generalizes to all interactions. The key physical idea is that Nature is theoretician friendly: if quantum coherence is to be preserved, a phase transition replacing the ordinary Planck constant $\hbar$ with $\hbar_{eff}$ must take place, when the interaction strength $Q_1Q_2/4\pi\hbar$ becomes too large for the perturbation series to converge. The alternative option is that the system decomposes to coherent subunits such that the perturbation series converges for them. This means a reduction of quantum coherence scale.

The understanding of atomic and molecular physics at the space-time level has been a long-standing challenge of TGD.

1. I have proposed that $h_{eff} > h$ for the valence bonds as flux tubes could allow us to gain insights about the periodic table [L20]. Monopole flux tubes can also carry ordinary electric fluxes and this would allow us to understand the recent empirical findings about chemical bonds as carriers of electric flux [L8]. TGD also suggests a flux tube model for hydrogen bonds. Also a generalization of hydrogen and valence bonds involving quantum gravitation in the TGD sense [L13] can be considered so that quantum gravitation would define an essential part of biochemistry.

2. What about atoms in TGD Universe? The proposed description for the gravitational interaction at the level planetary system in terms of flux tubes could generalize almost as such to a description of electromagnetic interactions at the atomic level. The U-shaped flux tube pairs with opposite magnetic charges and carrying electromagnetic flux besides monopole magnetic flux would emanate from protons and connect them to electrons. For a pair of opposite charged particles, the U-shaped flux tubes would be closed. For ions the flux tube pair would continue outside the atom. The flux tubes of a given atom could also form flux tube bundles. Also linking and knotting are possible for the flux tubes so that the capacity for topological quantum computation emerges.

3. A powerful restriction comes from the condition that monopole flux tubes must be closed. The proposal is that they are U-shaped and form pairs of flux tubes connecting two systems. This does not require that the Kähler electric charges of the members are opposite. For gravitational flux tube pairs they are of the same sign. For gauge interactions they are of the same sign but the sign can vary.

There are many topics related to flux tubes, which are not considered in this article.

1. TGD predicts homologically non-trivial flux tubes: in the simplest situation $X^4 = X^2 \times S^2$, the CP_2 projection S^2 is a homologically trivial geodesic sphere. If they are allowed by the preferred extremal property, they would serve as natural correlates for the Maxwellian magnetic fields. One cannot exclude flux tubes with light-like boundaries, and they would be even more natural counterparts for Maxwellian fluxes.

   In the standard terminology of condensed matter physics [L9], they would correspond to the magnetization M, whereas the monopole part of the measured magnetic field, which needs no currents as its sources, would correspond to the magnetizing "external" field H, which can be said to control M (and possibly containing $h_{eff} = h$ phases). The presence of monopole fluzes allows us to understand the puzzle posed by the fact the magnetic field of Earth is non-vanishing although dissipation of currents implies the decay of the Maxwellian part.

2. Interesting questions relate to the many-sheeted space-time. Monopole fluxes can flow between two space-time sheets through wormhole contacts. Elementary particles have wormhole contacts as building bricks [L10] [**?**, **?**]. Can one separate this level from the levels just discussed. For instance, can one consider closed flux loops travelling through several sheets in long length scales as the hierarchy of Planck constants would suggest.

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