Contents

1 Comments inspired by the critical questions by Vasileios Basios

I hope that these hastily written comments could serve as answers to your questions, at least to some degree!

1.1 Q1: Is operational distinction between BSFR-induced time reversal and thermodynamic time reversal possible

BSFR induced time reversal occurs at quantum level and induces thermodynamic time reversal in shorter scales. Time reversal is not possible in standard thermodynamics so that the question is not quite clear to me.

A natural assumption is that the magnetic/field body as a controller induces an effective change of the arrow of time at shorter scales. The general signature of BSFR is dissipation in a "wrong" time direction. Diffusion and heat transfer occur in the wrong direction.

In the following I will consider BSFRs in more detail.

1.1.1 Some examples of BSFRs

1. One half of the universe should have a reversed arrow of time! Magnetic ghosts with large h_{eff} would be everywhere!

2. The negatively charged EZs appearing in Pollack effect clean themselves: diffusion with reversed arrow of time. Also energy can be apparently extracted from the environment rather than fed from it.

3. Phase conjugate laser rays dissipate in opposite time direction [D1].

4. Libet's findings can be understood in terms of BSFR. The crucial question is whether the neural activity preceiding volitional acts occurs with an opposite arrow of time.

5. Fingelkurts brothers [L1] found that EEG period divides into two halves. Organized and chaotic: life and death.

6. Sleep as "small death". That there are no memories from the period of deep sleep is explained by the fact that classical signals from that period travel to the "wrong" time direction and do not reach the person after wake-up.

7. Homeostasis serves as a basic example in biology. The system is at the top of the hill and falling down all the time and making a time reversal to return back. The models based on computationalism require a complex hierarchical software involving control of control of ... in order to achieve this. In the TGD Universe it occurs automatically.

8. BSFRs as a universal mechanism behind conscious intelligence. Trial and error process by returning back in time and starting again. Problems are solved by dying for a moment. During sleep problems are indeed solved.

9. Earth's geological and biological evolution between creation of the Moon as an explosion throwing out a surface layer of the Earth and Cambrian Explosion (CE) [L16]. Sudden emergence of highly evolved multcellular life in CE from underground oceans as the radius expanded by factor 2.

1.1.2 Does BSFR induced self-organization-like process differ from ordinary thermodynamic self-organization?

Single BSFR induces time reversed dissipation, which as such does not correspond to self-organization although the dissipation can look as a self-organization when looked in the opposite time direction. Pairs of BSFRs induce observable effects in a given time direction and lead to self-organization since in SFRs the algebraic complexity is bound to increase in statistical sense.

Is it possible to distinguish BSFR induced self-organization-like processes as pairs of BSFRs (having interpretation as quantum tunnelling) from the ordinary thermodynamic self-organization involving thermodynamic phase transitions and thermodynamic criticality?

1. Feed of energy necessary in both cases. Induces ordinary self-organization in TGD at quantum criticality and the increase of complexity. h_{eff} increases.

   Cautious question: Could thermodynamic self-organization reduce to quantum self-organization?

2. The time reversed second law. Fantappie introduced the notion of syntropy as entropy with a reversed arrow of time [J6]. To my view, the apparent reduction of entropy for BSFR does not however correspond to self-organization. Pairs of BSFRs correspond to self-organization.

   Is it possible to understand this in terms of standard thermodynamics?

1.1.3 How to kill the BSFR hypothesis?

One can find evidence for BSFR but killing BSFR is not easy. BSFR makes sense only if systems with long range quantum coherence are possible. One could try the following.

1. Show that various biological effects explained by BSFR (such as SOC and homeostasis) can be explained without BSFRs. Computationalism would require development of hierarchical software: control of control of .... How the Universe obeying second law could achieve this? In TGD this is unavoidable.

2. Explain the phenomenon of sleep without BSFR.

3. Demonstrate that in Libet's experiments the neural activity corresponds to an ordinary arrow of time.

1.2 Q2. Holography = holomorphy hypothesis and qualitative character of consciousness

1.2.1 How qualia, felt qualities of experiences are produced

1. Holography = holomorphy hypothesis implies weak classical non-determinism (no failure of classical field equations). This non-determinism occurs already for 2-D minimal surfaces and space-time surfaces are predicted to be minimal surfaces.

   Conscious experience in SSFRs made possible by the classical non-determinism: entangled between two different quantum states (conscious-NESS refers to materialism and is a misleading term in TGD).

2. Reduction of entanglement between systems A and B in SSFRs. A corresponds to non-deterministic cognitive degrees of freedom of self. B could correspond to cognitive or ordinary degrees of freedom associated with A itself or B. There are several alternatives. Exotic modes of consciousness would correspond to different kinds of entanglements (cognitive-ordinary, cognitive-cognitive for system A for pair A-B).

3. Always a quantum measurement would be in question. Qualia are labelled by the values of observables assignable with the periods between 2 subsequent SSFRs. The first SSFR defines the context. Map from pairs of SSFRs→qualia. It is not possible to give formula for a quale.

4. Two kinds of values for observables.

   (a) Discrete quantum numbers. Could sensory qualia correspond to standard model quantum numbers? Color qualia as color quantum numbers for quarks with large h_{eff}. Findings of Barbara Shipman support this view [L3].

   There are also Galois quantum numbers and they could relate to cognition, in particular SSFR cascades associated with hierarchical downwards directed cognitive entanglement made possible by inclusion hierarchy of Galois subgroups associated with extensions of extensions... of rationals describable in terms of functional composition for the solutions of field equations.

   (b) Geometric qualia corresponding to measurements analogous to position measurements in WCW inducing a localization. The moduli of CDs are parametrized by a finite-D symmetry group. Poincare transformations, scalings, conformal transformations of M^4. Geometric time as the distance between the tips of a CD. Hierarchy of CDs gives rise to hierarchies of mental images.

   Also the selections of quantization axes define geometric qualia. The twistor spaces for M^4 and CP_2 (only these allow twistor spaces with Kähler structure and this also fixes TGD) define qualia. Barbara Shipman [A1] [L3] noticed that CP_2 twistor space $SU(3)/U(1) \times U(1)$ pops up in her model for honeybee dance.

1.2.2 Can one understand the unity of consciousness

1. In idealistic approach the problem is to understand why separate conscious entities seem to exist. It is hard to understand this as an illusion. In TGD the situation is different.

2. When entanglement is generated, unity of consciousness increases. When measurement occurs, entanglement is reduced and two separate systems emerge (Krishnamurti has talked about this a lot). Conscious entities are fusing and splitting all the time: analogy with particle reactions and chemistry.

3. Irreducible cognitive states cannot split by de-entanglement to a pair of systems. The Galois group has a hierarchy of subgroups and allows hierarchical entanglement having interpretation in terms of downwards directed attention. Simple Galois groups do not allow this and could correspond to cognitive consciousness without content or to basic bricks of cognition. The end of thinking.

4. Cognitive abstraction hierarchies defined by space-time surfaces. Take space-time surface $f = (f_1, f_2) = (0, 0)$. Form functional composites $g \circ f$ using maps $(g_1, g_2) : C^2 \to C^2$ mapping (0,0) to (0,0). $(f_1, f_2) = (0, 0)$ is still the solution of $g \circ f$. Infinite abstraction hierarchies with increasing size of Galois groups and complexity. What if f f does not allow composition $f = g \circ h$. Is this pure or primary consciousness? Archetypes of Jung?

1.3 Q3a Magnetic body and h_{eff} hierarchy

The findings of Blackman et al [J2] gave empirical motivations for h_{eff}.

1. Number theoretic interpretation is not completely fixed. Is h_{eff} as dimension of extension and of Galois group or degree of polynomial? For Galois groups, which are simple, h_{eff} would be a prime. Primes polynomials have prime degree. Spectrum of h_{eff} a measure for the evolutionary level of the organism.

2. Large h_{eff} phases are created at quantum criticality because long length scale fluctuations are involved.

   (a) Self-organized criticality (SOC) [J3] is poorly understood in standard physics. Could quantum criticality explain SOC?

   (b) Interactions between long and short scales typical in biology. EEG frequencies are extremely small. Large h_{eff} makes dark photon energies large so that interaction with shorter length scales is possible. Dark low frequency photon transforms to ordinary high frequency photon of a bunch of photons with the same frequency.

3. Energies grow with h_{eff} and it tends to be spontaneously reduced: reverse Pollack effect. Pollack effect induces transitions -OH $\rightarrow$ O^- + dark proton (-OH is hydroxide group) [L9, L13]. Metabolic energy transfer keeps the distribution of h_{eff} values as such.

   Not only photons do induce the Pollack effect. For instance, formation of molecules liberating energy could kick ions to monopole flux tubes.

4. Pollack effect would be in a central role at the ATP level. Inorganic phosphate P_i transforms to organic phosphate ion P as a proton with large h_{eff} is formed. The transformation ADP$\rightarrow$ATP $\rightarrow$ to acceptor takes place and. ATP$\rightarrow$ADP involves transfer of P to the acceptor and the dropping of the dark proton implies energy transfer to the acceptor.

5. Dark nuclei reside at monopole flux tubes: nuclear binding energy is much smaller than for ordinary nuclei but stabilizes the dark phase. This would occur in the case of DNA, cell,...,Earth.

   "Cold fusion" provides empirical evidence [L11]. Provides a short circuit to nuclear fusion at room temperature. Decay of dark nuclei to ordinary nuclei liberates practically all nuclear binding energy. Could be a basic process even in supernovas and at the surface of stars, outside stars, and even in nuclear collisions.

6. One intriguing piece of evidence for p-adic physics in biology. The p-adic length scales associated with (Gaussian) Mersenne primes $MG, k = (1+i)^k - 1$: $M_{G,151}$, $M_{G,157}$, $M_{G,163}$, $M_{G,167}$. These Mersennes define four miracle primes defining biologically important scales in the range 10 nm (thickness of the neural membrane),...,2.5 μm (size of the cell nucleus), which could be highly relevant for the DNA structure.

How to test this vision?

1. Disappearance of protons or ions as a signature for the ordinary to dark transformation. Conservation laws are apparently broken. This is possible also for electrons and there is evidence for this. Electrons are found to mysteriously disappear in rare earth metals when thermal energy is feeded. Systematic experiments with radiation with energy with precise transition energy could make easy to demonstrate the effect.

2. Pollack effect and its generalizations could have a central role in testing.

3. Testing at the level of subjective experience is possible for living matter. h_{eff} distribution flattens $\rightarrow$ system's IQ decreases, it gets tired and can even lose consciousness.

4. Predicted cyclotron transitions could serve as test. The experiments of Blackman and others could serve as a starting point. Cyclotron frequencies of biologically important ions. Bosonic ions like Ca and Mg forming BE condensates. Universal spectrum of cyclotron energies for gravitational Planck constant h_{gr} [E1] is predicted: no dependence on the mass of the ion.

5. Stability of the h_{eff} phases is achieved in some cases by the formation of dark nuclei at the magnetic body: DNA, nucleus, cell, neuron, trigeminal nerve, Earth are stable negatively charged systems suggesting that dark protons for dark nuclei at the magnetic body.

Gravitational and electric Planck constants are in a special role. As a matter of fact, it is not clear whether there are other kinds of effective Planck constants. There are two especially important cases: h_{gr} and h_{em} assignable to classical gravitational and electric fields.

1. For h_{gr}, the gravitational Compton length does not depend on particle mass and depends only on the solar mass or Earth mass, being 1/2 of Schwartschild radius $r_S = 2GM$. This reflects Equivalence Principle .5 cm for Earth, snowflake size for $v_0/c \simeq 1$. For Sun $v_0/c \simeq 2^{-11}$. $v_0/c = 1/n$, quantized. There are also corresponding universal frequencies.

   These predictions are very strong and could be killer predictions. The snowflake would have a roughly 1/10 times smaller in size on Mars!

2. h_{em} is proportional to a product Qq of charges must be so large that $Qq\alpha$ is larger than 1. For $q = 1$, Q must be large enough.

   For DNA it is proportional to the length of DNA strand and for cells it is proportional to the surface area of the cell membrane. For large neurons, in particular pyramidal neurons and the trigeminal nerve it is very large and would correspond to the highest IQ. For DNA strand pairs Q^2 is very large!

3. Ionic cyclotron transitions in the magnetic field of monopole flux tubes about $B_{end} = 2B_E/5 \simeq .2$ Gauss as a test [J2].

1.4 Q3b: Model for the genetic code as icosa tetrahedral tessellation of H^3

1. Hyperbolic 3-space is realized in particle physics as mass shell. It also corresponds to a light-cone proper time constant hyperboloids. There is huge number of hyperbolic tessellations as analogs of Euclidian lattices. Icosa tetrahedral tessellation of H^3 completely unique [L7].

2. Hyperbolic model for the genetic code emerged from a model for music harmony [L2, **?**]. Hamiltonian cycles for icosahedra are closed paths through all 12 vertices. Each Hamilton cycle defines a 12-note scale and triangles define 3-chords of a 20-chord harmony. Tetrahedron gives 4 chords. 3 different types of icosahedral harmonies and 3 different types of icosahedral harmonies plus single tetrahedral harmony defines bioharmony with 64 chords/triangles.

   Aminoacids correspond to orbits of the triangles under the symmetries of the Hamiltonian cycle: Z_6, Z_4 or Z_2. The numbers of the codons coding for a given amino-acid are predicted almost exactly.

3. Physical representation of codons as dark proton triplets at the vertices of triangular faces tetrahedron, octahedron and icosahedron. Dark protons are assignable to the monopole flux tubes parallel to the DNA strand.

4. Cyclotron transitions between dark genes represented as sequences of codons represented as dark proton triplets. For a gene with N codons the 3N cyclotron photons forming an analog of BE condensate emitted by dark protons give rise to a sequence of 3-chords. Music of light.

Music of light serves as as representation of emotions.

1. Music induces and represents emotions. Could emotional intelligence represented by the frequency triplets associated with the transitions between dark codons. 3N-resonances make possible the communications between genes.

   Emotions would be realized already at the level of DNA and RNA in terms of cyclotron transitions changing dark DNA configurations. Could they servemas building blocks of our emotions. Bioharmonies would correspond to molecular moods. Emotions would infect since they are realized by dark photons with very long wave length. This could explain phenomena like collective psychosis.

2. There is empirical evidence for RNA memory. Emotionally conditioned RNA from a sea slug is dispersed on neuron preparation and creates the same effect in the neurons as a real conditioning [J4] (see `http://tinyurl.com/y92w39gs`) [K1]. Explanation would be in terms of 3-N resonance at RNA and DNA level.

3. Dark genes are dynamic and could define a kind of R&D lab. Chemical genes are static.

One can make questions and speculative predictions:

1. Generalization of the genetic code as an induction of the tessellation to the space-time surface or lower-D surface is suggestive. Could cell membrane and microtubules provide a 2-D realization of the genetic code? Could the brain provide a 3-D realization? What about non-biological systems?: NASA has reported evidence for the plasma life in ionosphere [L8].

2. One objection against universal genetic code is the existence of synthetic codons. Codon number equals $N = 61, 57$ for them. This can be understood if some darp codons are not paired with chemical codons or the number of dark codons pairing with some codons is abnormally large.

   It is also possible to have $N \geq 64$. The same dark codons could pair with several chemical codons in a context-dependent way. Gariaev has found evidence for context dependence for ordinary genetic code. There are 2 amino acids for which DNA codon can also code for stop codon or some other amino-acid.

3. New realizations of the genetic code are in principle possible: the icosatetrahedral lattice is projected to the space-time surface. Also non-biological realizations. 2- and 3-dimensional realizations. Could cell membrane and microtubules realize 2-D genetic code.

4. Support for the role of the hyperbolic 3-space H^3 comes from the findings of Andres Gomez Nilsson. Attempt to understand psychedelic experiences in terms of the geometric of H^3 [L6].

1.5 Q4 Interdisciplinary Integration and Accessibility

Mutual translation can be seen as a basic challenge. How neuroscientist can understand TGD, which uses stronly mathematical language of physics. One can wonder how TGD and various theories of consciousness of neuroscience could relate. I must of course confess do not have a detailed view of various neuroscience theories and this comparison would be a highly interesting project. I have however written [K4] about Integration Information Theory [J5].

Some general comments about basic distinctions of neuroscience and TGD views are however possible. Distinctions are after all the most important information.

1. The basic difference with respect to competitors is that TGD predicts an entire hierarchy of conscious entities. There is not only single consciousness. Already Freud proposed Superego-Ego-Id triplet. Selves have subselves that they experience as mental images and are subselves of higher level selves.

2. Selves are also dynamic. They fuse and split and this would make conscious communications possible. There are also hierarchies of Galois groups which would be in vertical direction and relate reflective levels of consciousness.

3. Thalamocortical and other circuits and corresponding resonance frequencies are replaced with communications with the magnetic body of the brain. The cyclotron frequencies f_c of biologically important ions are involved and for $h_{gr} = GMM_{ion}/\beta_0$ f_c does not depend on the mass of the ion.

4. Gamma oscillations could relate to the formation of completely new mental images in BSFRs at some level. Revonsuo [J1] found that Eureka experiences in which a completely new pattern emerges involve gamma resonance. The example studied was the following: the subject person stares at a picture consisting of apparently random dots and suddenly a beautiful 3-dimensional object emerges.

   The generation and reduction of entanglement between brain regions and formation of larger neuronal units leading to the increase of h_{em} increasing the "IQ" could be involved. Here the magnetic body would be in a central role and 40 Hz EEG could correspond to dark photons with long wavelengths but energies above thermal threshold, say the energy range of biophotons.

   It is known that neurons from functionally nearby parts of the brain send signals to points of MB near to each other at MB so that functional geometry is mapped to ordinary geometry. MB response could force the neurons to oscillate in resonance.

5. In TGD one should not talk about consciousness but conscious experience made possible by the sequence of SSFRs. Pair of subsequent SSFRs defines the smallest unit of conscious experience, moment of consciousness with subjective duration correlating with the increase of the CD size defining geometric time. The experience of free will would be associated with SSFRs and involve non-deterministic change. Here several kinds of entanglements are involved.

6. Reduction of entanglement is the basic element of SSFR. In ZEO there is no violation of conservation laws since classical field equations are not violated since the basic object is space-time surface as analog of Bohr orbit for particle as 3-surface. This also solves the measurement problem.

1.6 Q5 Could any observation falsify TGD?

The observations related to fundamental physics provide the killer tests.

1. TGD predicts standard model symmetries and fields from very general number theoretic assumptions [L15, L12] and also from the assumption that the twistor spaces involved allow Kähler structure [**?**]. If it turns out that elementary particles with quantum numbers not explainable in terms of these symmetries definitely exist, TGD is dead.

2. TGD predicts also an entire hierarchy of standard models physics [L14]. This is due to the new view of QCD color as being analogous to angular momentum. Both quark-like and lepton-like spinor fields have an infinite hierarchy of multiplets from which physical hadrons and leptons emerge by color confinement. These multiplets give rise to a hierarchy of scaled variants of hadron physics. Simple p-adic scaling arguments allow us to estimate the hadronic mass spectrum.

   There is evidence for new hadron physics M_{89} with a mass scale scaled up by 512 from that of ordinary hadron physics [K2, K3]. M_{89} hadron physics is proposed to play a key role in the physics of Sun [L10] and explain solar wind and radiation from the Sun without assuming fusion in the core. These predictions could turn out to be killer predictions.

Long range classical electric/gravitational fields are characterized by electric/gravitational Planck constant.

1. h_{gr} depends only on astrophysical parameters (say masses of the Sun, Earth, and Moon) and this provides tests. How the possible life in Mars differs from that on Earth?

2. Personal h_{eff} hierarchy would characterize evolutionary level and would depend on the organism and also on tissue. As noticed h_{em} for DNA increases with length of gene (could it be proportional to the length of the entire DNA?). h_{em} is proportial to the area of cell membrane and long axons give rise to large values of h_{em}: nucleus, ordinary cell, neuron, pyramidal neuron, trigeminal nerve (, CNS).

   For the Earth h_{em} is proportional to the electromagnetic charge of the Earth. Comparison with the electric fields of other planets would be interesting.

3. Test whether quantum criticality at ordinary temperatures could be described in terms of h_{eff} hierarchy. Water at freezing point [L5, L4] and physiological temperature making Pollack effect probable. This predicts molecules for which it is possible to kick protons to dark protons: X-OH$\rightarrow$X-O$^-$ + dark proton [L9]. Living computers as analogs of living matter? Large negative charge of EZs would be the key signature.

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