

Article

More Precise TGD Based View about Quantum Biology and Prebiotic Evolution

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Abstract

In this work I try to clarify the relation of the basic notions of TGD and of TGD inspired biology to the ordinary bio-chemistry. I also try to improve my understanding about work of Fröhlich, Del Giudice, and Pollack using the notions of TGD. The key idea is the notion of coherence induced by weak em fields with preferred frequencies, which in ordinary quantum theory correspond to energies much below the thermal energy in quantum theory - this creates what is called kT paradox. In TGD framework one can do without coherence regions, which can be much larger. The basic observation is that for a pair of hydrogen bonded water molecules the reaction $2\text{H}_2\text{O} \rightarrow \text{H}_3\text{O}_2^- + \text{dark proton}$ require UV photon with energy of O-H bond of about 5.15 eV. Quantum criticality suggests that this process should occur spontaneously as a chain reaction. This is achieved in the same manner as in nuclear fusion if the dark protons at the flux tube fused to nuclear strings giving rise to dark nuclei. If dark nuclear binding energy transforms as Coulomb energy, the nuclear energy scale of MeV scales down to 1-10 eV - depending on the value of h_{eff} . An attractive guess is that the energy range of bio-photons corresponds to that for dark nuclear binding and excitation energies. Their spontaneous transformation back to ordinary nuclei would liberate energy could at least partially explain the evidence for bio-transmutations [3, 4]. Also the relation to cold fusion is interesting[32]. TGD inspired proposal for prebiotic evolution was inspired by the TGD based realization of Expanding Earth hypothesis and assumes that life evolved in underground oceans and burst on the surface of Earth in Cambrian explosion. This view leads to a more precise view about prebiotic evolution. Possible technological implications of this picture - if true - are quite impressive. Cold biofusion could make possible artificial generation of technologically important elements and the mechanism generating EZs could make possible creation of artificial intelligent life forms involving silicates and water.

1 Introduction

This work is an attempt to clarify the relation of the basic notions of TGD and TGD inspired biology - in particular the vision about prebiotic evolution - to chemistry and to the standard views about prebiotic evolution. There are frustratingly many different approaches and I have been working hardly to see whether TGD could allow to identify the common denominator of these approaches.

In TGD framework one can do without coherence regions (one could perhaps identify them as special cases of Pollacks EZs), which can be much larger. The basic observation is that for a pair of hydrogen bonded water molecules the reaction $2\text{H}_2\text{O} \rightarrow \text{H}_3\text{O}_2^- + \text{dark proton}$ require UV photon with energy of O-H bond of about 5.15 eV. Water clathrates are good candidates for the precursors of EZs since they have size scale in the same range as EZs and contain hydrogen bonded water. Quantum criticality suggests that this process should occur spontaneously as a chain reaction. This is achieved in the same manner as in nuclear fusion if the dark protons at the flux tube fused to nuclear strings giving rise to dark nuclei. If dark nuclear binding energy transforms as Coulomb energy, the nuclear energy scale of MeV scales down to 1-10 eV - depending on the value of h_{eff} . An attractive guess is that the energy range of bio-photons corresponds to that for dark nuclear binding and excitation energies. Their spontaneous transformation back to ordinary nuclei would liberate energy could at least partially explain the evidence for bio-transmutations [3, 4]. Also the relation to cold fusion is interesting [32].

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Dark nuclear binding energy is liberated as dark photons decaying into bunches of ordinary photons inducing further reactions $2\text{H}_2\text{O} \rightarrow \text{H}_3\text{O}_2^- + \text{dark proton}$ also other kind of dark ionizations. The size of EZs varies from about 1 micron to 100 microns. Suppose that the size scale of EZ corresponds to the wavelength of dark photon with energy of order dark nuclear binding, and that h_{eff} is such that the nuclear binding energy corresponds to the lower end about 1 eV in the range of bio-photon energies. If so then h_{eff}/h varies in the range 1 – 100. This would be the total number of dark photons resulting in the decay to ordinary photons.

In this process ordinary protons transform dark protons at magnetic flux tubes outside EZ. Dark ionization differs from ordinary ionization only in that the proton is dark. The difference between dark and ordinary ionization would define the borderline between ordinary and bio-chemistry (or dark chemistry). Chemical quantum criticality is possible also for other cations and also anions and all biologically important ions can appear as dark ions.

The Urey-Miller experiment was very successful: it produced a large variety of amino-acids crucial for life from simple basic constituents. The variant of this experiment has even produced adenosine, DNA nucleotide fundamental for ATP. There is however a severe problem. The prebiotic atmosphere was not reducing as in the Urey-Miller experiment simulating it.

Clays are good candidates for the key structures in prebiotic evolution since they can replicate. One can even speculate with an analog of genetic code. Phyllosilicates containing -O-H groups are especially interesting: they can adsorb basic biomolecules and induce their polymerization to oligomers. They also induce a formation of vesicles formed from lipid bilayer and serving as a candidate for a predecessor of cell. DNA is the problem and has led to a scenario known as RNA world. Phyllosilicates are also known to generate radiation with positive health effects. The natural and testable hypothesis is that the presence of EZs allows to circumvent the difficulties of the standard RNA world scenario and also generate DNA and biologically active phosphates containing the mysterious phosphate bond as ionized dark proton. The dark magnetic flux tubes and UV photon energy needed to generate EZs could be provided by gel in Pollacks's experiments and by electric discharges in Urey-Miller experiment. Also dark photons from the formation of dark nuclei decaying to bunches of bio-photons can be considered. Water clathrates can contain atoms and even micrometer sized phyllosilicate crystals, which could catalyze the formation of biomolecules at their surfaces as dark nuclear fusion chain reaction. Clathrate could also develop phospholipid bilayer around it - kind of primitive cell membrane.

TGD inspired proposal for prebiotic evolution was inspired by the TGD based realization of Expanding Earth hypothesis and assumes that life evolved in underground oceans and burst on the surface of Earth in Cambrian explosion. This view leads to a more precise view about prebiotic evolution.

Possible technological implications of this picture - if true - are quite impressive. Cold biofusion could make possible artificial generation of technologically important elements and the mechanism generating EZs could make possible creation of artificial intelligent life forms involving silicates and water.

1. The works of Fröhlich [17] and Del Giudice [13, 6] have served as a theoretical background in many attempts to develop quantum view about biology and consciousness. The first key idea is that weak em fields with frequencies, which correspond to energies much below the thermal energy in ordinary quantum theory, induce coherence/synchrony - maybe even quantum coherence - and that metabolic energy can be stored into Bose-Einstein condensate type states (https://www.youtube.com/watch?v=RjF1_eDEsqc). For instance, the work of Blackman [23] and others in turn suggests that cyclotron frequencies in magnetic field of .2 Gauss have effects on vertebrate brain.

Living systems are full of electrets and dipoles and charge separation in water environment is key aspect of living matter. Fröhlich sees electric dipoles and dipole oscillations as something fundamental. Also microtubule based view about consciousness relies on the ideas of Fröhlich. Del Giudice introduces the notion of coherence regions with size of about 1 micron as regions of water. Pollack [11] has discovered exclusion zones (EZs) as a characteristic of what he calls fourth phase of water. Charge separation occurs in EZs created in presence of gel: EZ is negatively charged and obeys $\text{H}_{3/2}$ stoichiometry instead of the usual. Part of protons goes outside EZ. Water clathrates

(https://en.wikipedia.org/wiki/Clathrate_hydrate) have size scales in the same range as EZs and could be precursors of EZs.

Questions: What does the coherence/synchrony forced by oscillating external emf really mean? Does it really create Bose-Einstein condensates for oscillatory modes coupled with it? How coherence regions and EZs emerge? Frequency clearly matters as in quantum theory but the photon energies are typically far below thermal energy: how can external emfs with extremely low frequencies have quantal effects?

2. The experimental work carried out to understand prebiotic evolution has led to various insights but no unified view exists. Urey and Miller [10] found that amino-acids emerge from simpler building blocks in an environment believed to mimic the boundary region between water, dry land, and atmosphere. The recipe for the prebiotic soup was simple: take simplest biomolecules such as NH_3 , CH_4 , water, lightnings to feed energy (they might have also some other functions), and assume reducing atmosphere. By adding some further simple ingredients also adenine essential for metabolism, was generated in this kind of environment. It has however become clear that the atmosphere very probably was not reducing.

Question: Is it possible to imagine any counterpart for the reducing atmosphere?

3. There is also a vision that clays represented prebiotic life. Clays form complex chemical and geometric structures consisting of layers microscopically, and also replicate by simply splitting to two. One can even speculate about a simple predecessor of genetic code. Perhaps chemical life evolved in symbiosis with clays.

Phyllosilicates (<https://en.wikipedia.org/wiki/Category:Phyllosilicates>) - in particular kaolinite and montmorillonite - are most studied clays. There is large variant of them containing basic biologically important ions in their lattice structure. Montmorillonites adsorb amino-acids and RNA nucleotides and promote polymerization of oligomers of RNA although the lengths of the resulting oligomers are considerably shorter than required by RNA world. DNA is not obtained since it is highly unstable in ordinary water. Even vesicles formed by double lipid layers are formed and could serve as predecessors of cells. But something is clearly missing.

Questions: What is needed to get longer RNA strands and perhaps even DNA? How could one obtain prebiotic genetic code? What kind of environment could contain the biologically important atoms/ions in particular phosphate ion?

4. One can try to combine the experimental vision with the theoretical visions of Fröhlich and Del Giudice and with the experimental discoveries of Blackman and Pollack. This leads to ask whether the layers phyllosilicate structures could generate frequencies which promote coherence (maybe even quantum coherence) in living matter. It is now known (as I learned from Hans Geesink) that phyllosilicates have positive effects on health. Maps are constructed for their frequency spectrum and it is even found that they can serve as kind of frequency storage - this is analogous to water memory [30]. Even cyclotron frequencies assignable to .2 Gauss magnetic field have been identified, and there is evidence that the powers of 3 and 2 about these frequencies are also biologically important. Quite generally, the THz/microwave region for which energies are below thermal energy (kT paradox) seems to be of special importance.

Questions: Could basic biomolecules and surfaces of phyllosilicate layers in interaction with water have been predecessors of the recent chemical life? Water clathrates can contain various elements and probably also phyllosilicate crystals: could their transformation to EZs be an essential step in prebiotic evolution?

TGD suggests an answer to the questions posed above.

1. In TGD Universe dark matter corresponds to ordinary matter with large value $h_{eff} = n \times h$ of effective Planck constant. The oscillating classical em fields are classical correlates for dark photons. This solves the kT paradox. The forced oscillations are induced by absorption of these quanta: macroscopic quantum coherence forces the coherence of ordinary biomatter.

The additional assumption $h_{eff} = h_{gr} = GMm/v_0$ [45, 38] (to be explained in more detail later) implies universal energy spectrum for dark cyclotron photons and their transforms to ordinary photons can be identified as bio-photons [41] in energy range containing visible and UV frequencies. Generalized Josephson radiation from membrane proteins acting as generalized Josephson junctions has also a branch for which energy spectrum is universal but frequencies depend on h_{eff} . These two dark photon species are used by magnetic body to control, coordinate, and communicate with ordinary matter in living systems.

2. In TGD framework one can do without coherence regions (one could perhaps identify them as special cases of Pollacks EZs), which can be much larger. The basic observation is that for a pair of hydrogen bonded water molecules the reaction $2H_2O \rightarrow H_3O_2^- + \text{dark proton}$ require UV photon with energy of O-H bond of about 5.15 eV. Water clathrates (https://en.wikipedia.org/wiki/Clathrate_hydrate), whose importance Hans Geesink emphasizes [18], are good candidates for the precursors of EZs since they have size scale in the same range as EZs and contain hydrogen bonded water. Quantum criticality suggests that this process should occur spontaneously as a chain reaction. This is achieved in the same manner as in nuclear fusion if the dark protons at the flux tube fuse to nuclear strings giving rise to dark nuclei.

If dark nuclear binding energy transforms as Coulomb energy under scalings of h_{eff} inducing similar scaling of the size of the system, the nuclear energy scale of MeV scales down to 1-10 eV - depending on the value of h_{eff} . An attractive guess is that the energy range of bio-photons corresponds to that for dark nuclear binding and excitation energies. Their spontaneous transformation to ordinary nuclei would liberate energy could at least partially explain the evidence for bio-transmutations. Also the relation to cold fusion is interesting.

Dark nuclear binding energy is liberated as dark photons decaying into bunches of ordinary photons inducing further reactions $2H_2O \rightarrow H_3O_2^- + \text{dark proton}$ also other kind of dark ionizations. The size of EZs varies from about 1 micron to 100 microns. Suppose that the size scale of EZ corresponds to the wavelength of dark photon with energy of order dark nuclear binding, and that h_{eff} is such that the nuclear binding energy corresponds to the lower end about 1 eV in the range of bio-photon energies. If so then h_{eff}/h varies in the range 1 – 100. This would be the total number of dark photons resulting in the decay to ordinary photons.

In this process ordinary protons transform dark protons at magnetic flux tubes outside EZ. Dark ionization differs from ordinary ionization only in that the proton is dark. The difference between dark and ordinary ionization would define the borderline between ordinary and bio-chemistry (or dark chemistry). Chemical quantum criticality is possible also for other cations and also anions and all biologically important ions can appear as dark ions.

3. Dark proton states correspond to states of DNA, RNA, amino-acids and tRNA and therefore provide a fundamental representation of genetic code. The dark ionization of -O-H:s of any linear molecular structure generates dark proton sequence. In particular, the -O-H in phosphate of DNA nucleotide can become O^- plus dark proton, so that one has pairing or DNA with dark proton sequence carrying the genetic information. This splitting can occur also for amino-acids containing -O-H as standard part and also for ATP. Dark ionization can also occur for -O-H:s at of phyllosilicates layers and at their 1-D boundaries. Depending on the correlation between dark proton states and phyllosilicate units one could have an analog of genetic code. One can also imagine formation of DNA, RNA, etc... as their inorganic forms "steal" dark proton sequence from phyllosilicate: dark proton sequence would serve as a template. This would make possible very effective generation of complex biopolymers.

4. As Geesink emphasizes [18], clays are good candidates for the key structures in prebiotic evolution since they can replicate. One can even speculate with an analog of genetic code. Phyllosilicates containing -O-H groups are especially interesting: they can adsorb basic biomolecules and induce their polymerization to oligomers. They also induce a formation of vesicles formed from lipid bilayer and serving as a candidate for a predecessor of cell. DNA is the problem and has led to a scenario known as RNA world. Phyllosilicates are also known to generate radiation with positive health effects.

The natural and testable hypothesis is that the presence of EZs allows to circumvent the difficulties of the standard RNA world scenario and also generate DNA and biologically active phosphates containing the mysterious phosphate bond as ionized dark proton. The dark magnetic flux tubes and UV photon energy needed to generate EZs could be provided by gel in Pollacks's experiments and by electric discharges in Urey-Miller experiment. Also dark photons from the formation of dark nuclei decaying to bunches of bio-photons provide this energy.

Water clathrates serving as precursors of EZs can contain atoms and perhaps even micrometer sized phyllosilicate crystals, which could catalyze the formation of biomolecules at their surfaces as a dark nuclear fusion chain reaction. Clathrate could also develop phospholipid bilayer around it - kind of primitive cell membrane. A possible objection is that Pollack observed that EZs repel impurities from their interior. What "impurity" exactly means is of course a crucial question.

5. Prebiotic life could have evolved in underground oceans - even below the Earth's crust. The metabolic energy feed could have come as dark photons from the core, whose temperature is rather near to that of solar radiation. Also dark photons from solar radiation could have contributed. EZs could have been generated by dark UV quanta accompanying lightnings. Dark photons would propagate along dark magnetic flux tubes through the crust and transform to bio-photons in underground oceans (this is not the only possibility).

Geesink [18] mentions that FIR and THz/microwave radiation is accompanied by the clathrate aerosols in atmosphere, which suggests the importance of atmosphere. If EZs generated by solar radiation from clathrates are present, this radiation could be dark and have energies above thermal energy and propagate along dark magnetic flux tubes. EZs could also transform ordinary solar radiation to dark radiation so that the radiation from atmosphere could enter underground oceans as dark radiation.

In Cambrian explosion the radius of Earth was doubled (in TGD Universe cosmic expansion occurs in rapid jerks at the level of astrophysical objects in given scale) the underground life was burst to the surface of Earth [29].

Possible technological implications of this picture - if true - are quite impressive. Cold biofusion could make possible artificial generation of technologically important elements and the mechanism generating EZs could make possible creation of artificial intelligent life forms involving silicates and water.

2 Background

Recently I have had very interesting discussions with Hans Geesink (<http://www.biotech-silicates.com/en/team-3/>) and have also received a lot of highly interesting material from Hans, in particular his book "Proposal for a quantum field theory about coherence concerning non ionizing radiation" [18], which can be found from his blog (<https://geesinkresearch.wordpress.com>). His views have much in common with my own vision and differences are especially useful since they force to direct attention to ideas that I have not directed enough attention.

2.1 About experimental work of Hans Geesink

I was contacted by Hans Geesink, who works in BioTech Silicates, which tries to develop technology intended to reduce negative health effects caused by man-made non-thermal non-ionizing radiation involving typically frequencies from ELF (EEG region) to far infrared region. These effects are caused by EMFs from antennae, mobile phones, and power cables. Perception tests are carried out to see the possible effects on well-being.

Using the words of Geesink:

We have measured more precisely the resonances of the phyllosilicate minerals (used to compensate negative biological effects caused by non thermal non ionizing radiation; having multiple stacked sheets; each platelet 1 nanometer thick, and in stacks of micrometers, and total lengths of more than earth diameter, able to be organized as a metamaterial, nearly all types of ions incorporated in and between the platelets and we measured: quantized light, IR and FIR spectra properly ordered in powers of 2, and ratios of 1:2, 2:3, and adding multiple frequencies of 2 and 3.

The general vision is that weak external em fields oscillating at frequencies utilized by biosystems to coordinate their behavior by inducing coherent oscillations make possible coherence and perhaps even quantum coherence. The man-made emfs tend to destroy this coherence and weak emfs would restore the coherence if the frequencies are correct. Phyllosilicates seem to provide the materials producing the correct frequencies.

2.2 Some theoretical ideas

In his articles Geesink has done hard work in building a unified view about the enormous literature related to the biosystems and quantum coherence. Geesink sees the role of classical oscillating em fields central in biology. These fields somehow give rise to the coherent behavior of biomatter and perhaps even quantum coherence. Fröhlich is one of the pioneers, who thought that electric dipoles and dipole oscillations could be central in living matter and give rise to analogs of Bose-Einstein condensates. A further important notion would be that of coherence region developed by Del Giudice as a quantum field theoretical (QFT) concept important for understanding of quantum biology. Unfortunately, this notion is not established experimentally unlike the exclusion zones (EZs) discovered by Pollack. In the following I try to relate these ideas to TGD framework.

2.2.1 Fröhlich's ideas

Fröhlich [17] (see <http://onlinelibrary.wiley.com/doi/10.1002/qua.560020505/abstract>) proposes the importance of liquid crystals (https://en.wikipedia.org/wiki/Liquid_crystal) and electric dipoles in biology. Cell membrane is only one example of liquid crystal and electret important in biology. Already Becker [22] demonstrated that electric potentials serve as correlates of consciousness. Fröhlich suggests the importance of the longitudinal em modes assignable to dipole oscillations and metabolic energy storage as analogs Bose Einstein condensates (<http://www.springer.com/us/book/9783642733116>). For instance, the tubulins inside microtubules are electric dipoles and Hameroff was the first researcher to propose that they might be important for consciousness. I have myself developed this idea from TGD perspective in a model of anesthetes based on electric fields associated with microtubules and give rise also to Becker's DC currents as supra-currents inside microtubules [36].

One can imagine that dipole oscillations are quantized just like sound waves. Mathematically this is not a problem. The simplest situation corresponds to electrons oscillating in unisono with respect to the ionic lattice and accompanied by an electric field varying in a periodic manner. These oscillations can propagate and define longitudinal electric waves analogous to longitudinal sound waves.

Personally I am a little bit skeptic about quantizing the plasma oscillations but I might be wrong - also acoustic oscillations are quantized. The point is that the density of electrons appears in the formulas for frequencies, which suggests that a phenomenological description is in question. But the density of particles appears also in the frequency for sound waves and we talk fluently about phonons!

I would propose that both phonons and plasma waves have a genuine quantum description at deeper level. In TGD this deeper level would correspond to strings connecting points of partonic 2-surfaces serving as carriers of fermion number. The oscillations of strings would be fundamental besides the oscillations of their ends. Even elementary particles would consist of pairs of wormhole contacts in turn consisting of two partonic 2-surfaces at parallel space-time sheets and connected by strings and string oscillations would represent the fundamental phonons. Phonons would be 2-particle phenomenon and photons single particle phenomenon. This two-particle aspect is missing from QFT description. In string model description only the string aspect is present. In TGD both are involved and this is crucial for obtaining macroscopic gravitationally bound states: in TGD framework string model is doomed to be only a model of gravitation in Planck length scale.

Fröhlich uses the phrase "Governed by negentropy". The notion of negentropy has somewhat fuzzy content in standard physics framework.

1. Fantappie [24] introduced the notion of syntropy, which in zero energy ontology (ZEO) can be regarded as entropy but with different arrow of time. Spontaneous self assembly would be a process, which would be decay in the reversed direction of time and obey time reversed second law.
2. I have talked about Negentropy Maximization Principle and number theoretic negentropy [31, 46]. NMP defines the basic variational principle behind state function reduction central for both TGD and TGD inspired theory of consciousness.

Number theoretical entropy is a variant of Shannon entropy for which the probabilities appearing as arguments of logarithms are replaced with their p-adic norms: this requires that probabilities are rational or at least algebraic numbers. If the entanglement probabilities do not belong to the algebraic extension of rationals used, the entanglement is rather stable since it requires a phase transition to large algebraic extension.

The final states of state function reduction can have non-vanishing rational entanglement probabilities with projector as a density matrix: this corresponds to unitary entanglement matrix. The number theoretic entanglement entropy is negative for these states and one can say that entanglement carries information. NMP is not in conflict with second law: the thermodynamical ensemble entropy characterizes the average particle of ensemble and entanglement entropy characterizes pair of systems. Second law would however hold true only when restricted to the visible sector with standard value of Planck constant.

3. The most powerful implications of NMP in Zero Energy Ontology (ZEO) are precise identification of self as the sequence of state function reductions at a fixed boundary of causal diamond (CD). This leads to the understanding of metabolism and homeostasis as the attempt of conscious entities (selves) to survive: the "death" of self occurs in the first state function reduction to the opposite boundary of CD and actually means re-incarnation in geometric past as far as sensory input is considered. Selves do not however know about this(!) and fight for survival trying to gather negentropy associated with sub-selves to satisfy the needs of NMP. Metabolism is at deeper level gathering of negentropy resources as negentropic entanglement and nutrients are carriers of the negentropic entanglement. This picture is a powerful guideline in attempts to understand how the prebiotic life was initiated.

2.2.2 Forced coherence, coherence regions, and exclusion zones (EZs)

The notion of forced coherence is crucial idea behind the development of devices allowing to reduce the negative health effects caused by man-made non-thermal non-ionizing radiation. Coherent em fields at various frequencies are assumed to play a key role in bio-coordination and artificially generated emfs interfere with this coordination causing negative health effects.

The use of phyllosilicate based devices is argued to help to re-establish the coordination if they generate radiation at frequencies important for maintaining biological coherence via external weak synchronizing

signal (for illustration of synchrony see https://www.youtube.com/watch?v=RjF1_eDEsqc). If phyllosilicates indeed achieve they might have played important role in prebiotic evolution.

Del Giudice [6] [13] has introduced the notion of coherence region. These regions would have size of order 1 micrometer and would be characterized by both acoustic and plasma oscillations induced by the synchronizing external fields. Velocity of propagation is dramatically reduced.

I have considered a model of coherence regions as a phase of water in which certain fraction of -O-H bonds of water molecules are excited to high energy state with energy around 4.8 eV and near the bond breaking energy about 5.15-5.3 eV so that only metabolic energy quantum of about in the range .05-.3 eV is needed to break these bonds. Note that $.05 \times Z$ eV corresponds to the minimal energy assignable to protein Josephson junctions of neural membrane and that .3 eV is slightly below the nominal value of metabolic energy quantum with nominal value of .5 eV. This would give rise to the formation of fourth phase of water discovered by Pollack [11]. It however turns out that one can do without coherence regions in TGD framework.

The Exclusion Zones (EZs) of Pollack are generated in water bounded by gel in presence of irradiation by visible light. They have sizes up to 100 micrometers - the size of large neuron - are a fundamental concept in TGD inspired attempts to understand living matter. EZs have high electron density and obey the stoichiometry $H_{3/2}O$. Part of protons must go outside the EZ and TGD inspired proposal is that they go to dark protons at magnetic flux tubes.

Electrons inside EZ have large Fermi energy above thermal energy - maybe even of order 1 eV as in condensed matter - and could be key players in TGD based mechanism of bio-super-conductivity. The electrons would be transferred to magnetic flux tubes as dark electrons at quantum criticality. EZs would accompany all bio-active molecules in particular DNA, which has charge -e per nucleotide associated with the phosphate. Also microtubules possess GTP molecules with same charge. The basic problem is to understand how the EZs and coherence regions or clathrates as their possible precursors can be created.

Quantum criticality is a key notion of quantum TGD and TGD inspired biology but has been discussed also by other scientists. For instance, Stuart Kauffman has developed this notion [19] (<http://arxiv.org/pdf/1502.06880v2.pdf>). There are of course many views about quantum criticality: the characteristic difference between TGD inspired proposal [44] and other proposals is that quantum theory is generalized by introducing the hierarchy of Planck constants $h_{eff} = n \times h$ labeling a fractal hierarchy of isomorphic sub-algebras of so called super-symplectic algebra having the structure of conformal algebra.

2.2.3 Water clathrates

Geesink emphasizes [18] the importance of water clathrates or clathrate hydrates (https://en.wikipedia.org/wiki/Clathrate_hydrate) - crystalline water based solids resembling ices and consist of hydrogen bonded water. Clathrates contain also guest molecules such as small non-polar molecules (typically gas molecules) and polar molecules with large hydrophobic moieties (parts) trapped inside "cages" of hydrogen bonded frozen water molecules. Methane is one gas trapped in deposits of methane clathrate. Clathrates appear also at outer planets, moons, and trans-Neptunian objects.

The size scale range for clathrates varies from 1-100 micros and is same as for EZs of Pollack and the natural identification would be as precursors of EZs. This makes clathrates ideal prebiotic structures inside which molecular life could have evolved.

Geesink notices also the significance of atmospheric aerosol of water clathrates as emitters of radiation in FIR and THz/microwave region inducing coherence and transition between protein conformations and Rydberg states (https://en.wikipedia.org/wiki/Rydberg_state). Rydberg states themselves could be excited by UV radiation. The absorption of solar light could transform also atmospheric clathrates to EZs.

3 Basic TGD based vision about quantum biology

From TGD point of view the findings discussed by Geesink in his article [18] are highly interesting for several reasons. Geesink underlines the importance of external classical fields as inducers of coherence which differs from ordinary coherence in that there is external energy feed as in self-organizing systems, and also the importance of coherence regions of size about 1 micrometer. This raises questions.

1. Is the coherence really quantal or is it the external classical fields classical correlates for quantum coherence? Can one really speak about Bose-Einstein condensates of longitudinal oscillations of electric or is a more fundamental quantum description needed?
2. Do the coherence regions of del Giudice exist except as theoretical entities? What is their origin in TGD Universe if they exist? Could the EZs of Pollack- , which certainly exist - involve the fusion of coherence regions accompanied by a phase transition to $H_{1.5}O$ stoichiometry generating charge separation. Or could one do without coherence regions as separate entities and perhaps identify them with EZs? Or could water clathrates replace them as precursors of EZs? Note that theoretically the size of coherence regions would be about 1 micrometers whereas the sizes of EZs vary up to 200 micrometers. The clathrate option looks to me highly attractive.
3. Geesink reports that the phyllosilicate minerals created in the interaction of water with silicate minerals and possessing characteristic -O-H groups have positive health effects and can be used to reduce the negative effects caused by man-made non-ionizing radiation. When doped with biologically important ions they produce specific biological effects characterizing the ion and also the cyclotron frequencies assigned to .2 Gauss magnetic field by Blackman are detected.

This leads to a series of questions.

- (a) Could the physics of phyllosilicate-water system involve EZs and possibly also coherence regions in a key role? -O-H groups and their ionized variants $-O^-$ are a common denominator of both water, biologically active phosphate and there of DNA and RNA nucleotides as well as phospholipids containing phosphate, of amino-acids, etc...

Could the transformation of -O-H to $-O^-$ plus dark proton be the fundamental reaction generating dark protons. Note that this transformation would be dark counterpart for what happens as acid gives up proton. For instance, a fraction of water molecules characterized by pH decomposes to OH^- and H_3O^+ ions. In presence of EZ this process would produce dark H^+ rather than H_3O^+ ions.

This generalizes to other cations and also to anions. The distinction between dark anion/cation (usually proton/electron) is the boundary between non-organic chemistry and bio-chemistry.

- (b) Phyllosilicates involve all biologically important ions: did their dark variants emerge already in the prebiotic phase in the interaction of water with phyllosilicate? What is this interaction? Could the process -O-H to $-O^-$ also phyllosilicates in interaction with fourth phase of water and transform also the biologically important ions to their dark counterparts and at the same time ionize the mineral surface?
4. What makes possible coherent generation and liberation of metabolic energy? Is this a quantum coherent process or chain reaction as the model for the generation of EZ suggests or are both options realized?
5. Quantum criticality and dark variants of biologically important ions. What is the mechanism giving rise to the pairing of the biopolymers with their dark analogs at magnetic flux tubes? How dark ions such as K^+, Na^+, Ca^{++}, Cl^- are generated? Could the interaction of water with EZs provide a prebiotic mechanism for the generation of these dark ions?

6. Cell membranes consisting of double lipid layers are in TGD Universe Josephson junctions and Josephson currents between them generate Josephson radiation with energy, which is just above the thermal energy and have frequency proportional to $1/h_{eff}$ and thus give rise to classical counterpart of THz radiation known to be important in the interaction of phyllosilicates with living matter. It is known that vesicles consisting of lipid bilayers are formed in water-montmorillonite system. Could the predecessor of cell emerge in water-phyllosilicate interaction?

Phyllosilicates appear in bi- and triple-layered structures and are semiconductors. Could they act - perhaps in presence of EZs - as high temperature superconductors in the sense that their resistance would be associated only with the ends of the "wires" (the resistance would be thus independent of length)? Could a charge separation develop in the presence of EZs so that there would be potential difference through the layered structure? Could the layers form Josephson junctions generating radiation with energy above thermal energy and frequency determined by the value of h_{eff} ? The lattice spacing for layered structures is of order 1 Angstrom so that one expects Josephson energy ZeV to have order of magnitude of 10^2 eV.

7. Doped phyllosilicates are also catalysts and could have served as prebiotic bio-catalysts. A highly attractive idea is that both prebiotic molecules, atoms of various elements, and phyllosilicate crystals were trapped inside water clathrates so that all important building bricks of bio-molecules would have been automatically inside EZs after their birth.

3.1 How could external fields induce coherence?

By general arguments (Planck constant is too small) the coherence induced by classical fields in visible matter is like forcing soldiers to march in the same pace and should not be regarded as a genuine quantum coherence. Quantum coherence would be at deeper level and allows to understand why the external classical field is coherent in long scales. In TGD Universe resonance frequencies of EEG etc... perform this task in brain functioning and dark EEG photons are behind EEG mediating sensory information to magnetic body and control commands back to biological body [27]. (Quantum) criticality is the key notion: at (quantum) criticality large h_{eff} dark matter phases can appear. In applications one should try to identify quantum critical aspects of systems considered.

In TGD framework dark cyclotron photons having oscillating fields as classical correlates and with energy $E = h_{eff} \times f$ above thermal threshold would be inducers of coherence. This picture solves the kT paradox, which originally led to $h_{eff} = n \times h$ hypothesis, which can be now deduced from the number theoretic vision about TGD [46]. Dark cyclotron photons could transform to ordinary photons in energy conserving manner and have biophotons as their decay products with energies in visible and UV range. $h_{eff} = h_{gr}$ hypothesis [45] implies that dark cyclotron photons and therefore also bio-photons have universal spectrum reflecting the spectrum of magnetic field strengths.

The model for cell membrane as generalized Josephson junction can act also as an ordinary Josephson junction and thus allows also a piece of spectrum with Josephson photon energy coming as multiples of $E = ZeV$, V resting potential, where Z is the charge of the superconducting charge carrier. Just in the vicinity of thermal threshold for $Z = 2$ (Cooper pairs or Ca^{+2} , Mg^{+2}). Dark Josephson radiation with energies near thermal energy and with frequency inversely proportional to $1/h_{eff}$ so that arbitrary low frequencies would be obtained. These dark photons have always same energy irrespective of the value of h_{eff} .

THz/microwave frequency range is considerably below the thermal threshold for the ordinary value of Planck constant and dark Josephson photons with appropriate value of Planck constant could be transformed to these photons. The simplest transformation is the decay of the $n = h_{eff}/h$ sheeted space-time surface to n sheets each carrying ordinary THz photon. Also energy conserving decay to single photon can occur. The values of Planck constant would not be very large for THz range if Josephson photons are in question. The dark THz/microwave photons emitted by say EZs generated from atmospheric

water clathrates by solar radiation could propagate through the crust along magnetic flux tubes to the underground oceans.

The basic mechanism in the interaction of dark matter with visible matter would be phase transition transforming dark photon to ordinary photon(s) in energy conserving manner. All particles can be in dark phase and this makes possible super-conductivity and superfluidity.

3.2 Coherence regions and EZs

The proposal of del Giudice is that what he calls coherence regions/domains play a central role in biology and are induced by oscillating external fields by forcing units of visible matter to march in the same rhythm. In TGD framework one must take a skeptic attitude towards the existence of coherence regions postulated by del Giudice. To my best knowledge there is no direct experimental support for coherence regions and they might be identifiable as special cases of EZs.

1. EZs of Pollack are an experimental fact and are generated in presence of gel phase and incoming radiation. The open question is whether gel phase also serves as an energy source or does it have some kind of control function feeding in information. It might well be that coherence regions of del Giudice are not needed and the water clathrates serve as natural precursors of EZs. The transition *hydrogen bonded* $2H_2O \rightarrow H_3O_2^- + \text{dark proton}$ could be induced by UV light as breaking of -O-H bond.

EZs carry negative electronic charge and part of protons would become dark and would be transferred to the dark magnetic flux tubes. Dark protons form sequences, which could be seen as scaled up variants of atomic nuclei in the first approximation. The states of dark proton in the model that I have proposed are in one-one correspondence with DNA, RNA, amino-acids, and 40 tRNA states [30]. The coherence regions could be created by UV light splitting -O-H bonds and possibly also other kinds of bonds to the verge of phase transition. Later various options for the energetics of coherence regions are discussed.

The simplest assumption is that nuclear binding energy transforms as Coulomb potential in the scaling of $h \rightarrow h_{eff}$ scaling also the system size. If so, the dark nuclear energy spectrum could be that for bio-photons and basic bio-molecules. The transformations of dark nuclei to ordinary nuclei could take place and would provide new source of nuclear power and ability to artificially generate elements: there is indeed evidence for biofusion [3, 4].

2. If the coherence regions of del Giudice exists they must relate closely with EZs. The simplest TGD inspired analog would be as micron sized regions as regions near criticality of a phase transition of water to fourth phase of Pollack. The simplest guess is that Josephson energy quantum for cell membrane (above $.05 \times Z$ eV) or energy quantum somewhat below metabolic energy quantum $\sim .5$ eV is needed to transform H_2O stoichiometry to $H_{1.5}O$ so that EZ would be obtained. Hence the Josephson radiation from membrane protein Josephson junctions could have a role in the control of EZs. On the other hand, the hydrogen bonds EZs with high enough bond energy would be stable against absorption of Josephson radiation and metabolic energy quanta.

The proposal is that fourth phase of water realizes genetic code at the level of dark nuclear physics and ordinary biomatter has condensed around the dark matter. DNA, etc. are paired to the dark proton sequences representing their dark variants and transcription and translation occurs at the dark level primarily and ordinary biomatter makes this visible. The recent finding that so called knocked out genes are transcribed correctly [14] (<http://www.nature.com/nature/journal/vaop/ncurrent/full/nature14580.html>) supports this view [45].

3.3 Quantum criticality bio-chemically

Quantum criticality [44] has become key concept of quantum TGD and TGD inspired biology. Quantum criticality allows to understand the hierarchy of Planck constants and also its relationship to p-adic length scale hypothesis, whose origin reduces to number theoretic vision about TGD [46]. Dark matter phases characterized by $h_{eff} = n \times h$ accompany any quantum critical system, maybe even thermodynamically critical systems. The challenge is to find concrete realizations of quantum criticality in various scales. In biology biochemical realization is of special interest.

The basic aspect of quantum criticality is that the increase of h_{eff} occurs *spontaneously* since the process corresponds to increase of negentropy and NMP states that negentropic entanglement resources of the Universe are increasing as kind of Akashic records or cosmic library. At the level of selves this means that self "dies" and re-incarnates as its time reversal. Selves fight for survival and try to grow their negentropic resources to satisfy the requirements of NMP. This leads to metabolism and homeostasis characterizing living systems. The emergence of life would not be extremely rare accident but doomed to occur spontaneously sooner or later by basic law telling what happens in state function reduction in TGD Universe obeying Zero Energy Ontology (ZEO). Hence the process should occur spontaneously and increase h_{eff} .

1. The basic question is how quantum criticality is realized biochemically. Are the molecules excited near to a critical energy at which a dark ion at magnetic flux tube is generated and a phase transition analogous to that leading from ordinary to fourth phase of water occurs? Or are large systems near criticality to a generation of dark phase as the general vision about quantum criticality of TGD Universe suggests.
2. A natural assumption is that metabolic energy quantum should be able to induce the phase transition producing dark particles at criticality. Could dark photons in visible and UV range accompany criticality at the level of single molecule? Are cell membrane and neuronal membrane quantum critical systems and how they differ?
3. Dark variants of biologically important ions residing at magnetic flux tubes are in fundamental role in TGD inspired quantum biology. In particular, dark proton states are proposed to give rise to the dark analogs of DNA, RNA, amino-acids, and tRNA. The pairing of ordinary DNA/RNA/amino-acids with their dark analogs is expected to be fundamental in biology and transcription and translation are proposed to take place at dark level as the recent experimental findings indicate. How is this pairing realized? How ordinary DNA becomes paired with dark DNA or is it already paired with it?
4. What could be the fundamental mechanism liberating metabolic energy coherently? This question will be discussed later.

3.3.1 The role of fourth phase of water

Pollack's EZs [11] and fourth phase of water should be in key role.

1. EZs are generated under conditions equivalent with those prevailing in Pollack's experiments (water bounded by gel plus irradiation). Charge separation occurs: EZ is negatively charged and dark protons reside at magnetic flux tubes. This process could occur also for systems in contact with water such as phyllosilicates. Cations (in particular protons) or anions at these surfaces could be transferred to magnetic flux tubes. Dark proton sequences could realize the genetic code.
2. -O-H bond near quantum criticality would become $-O^-$ in the formation of EZs - most naturally from water clathrates since also EZs have crystal structure. Actually much more general process can be considered: also the -O-H bonds associated with say phyllosilicates in contact with EZ could

suffer the same fate. O^- appears in the phosphates associated with XTPs of DNA and RNA nucleotides, phospholipids, and with GTPs of microtubules. Are all these O^- s accompanied by dark proton in some spin state at parallel magnetic flux tube. In the case of DNA there should be a correlation between the code letter A, T, C, G and dark proton state. Could the 3-electron state possibly assignable to the codon be same as 3-quark state of corresponding dark proton? In particular DNA as topological quantum computer could involve pairing of dark protons associated with DNA and with phospholipids by flux tubes which can become braided.

3. -O-H bonds associated with $O=C-O-H$ is the basic building brick of amino-acid and could make it acid that is able to donate H^+ received by water molecule becoming H_3O^+ . Could amino-acid become biologically active as -O-H becomes $-O^-$ plus dark proton at flux tube possibly defining dark proton sequences dark variant of amino-acid as dark proton sequences? Another possibility is that the phosphorylation of amino-acids brings associates dark protons with amino-acids and can even generate dark nuclei. There should be a correlation with spin state of dark proton and amino-acid side-chain if genetic code is realized.
4. There is no need to restrict this mechanism to $-O-H \rightarrow O^-$. Any chemical bond could be kicked near to criticality either by the combination of dark and p-adic phase transitions liberating zero point kinetic energy or by dark photons absorbed in the time reversal of Bose-Einstein condensation. This would allow generation of dark variants of biologically important ions by EZs associated with phyllosilicates.

One could test this vision empirically by looking whether EZs induce generation of DNA sequences or at least dehydration of DNA and checking whether EZs could stabilize DNA against hydrolysis. Also the interaction between EZs and phyllosilicates could be studied.

3.3.2 Simplest model for the formation of fourth phase of water

The basic ideas about quantum criticality apply to the formation of EZs and possibly existing coherence regions serving as their predecessors. The simplest model for the formation of EZs discussed in the following does not require coherence regions at all and could occur spontaneously as a chain reaction. This is what Occam's razor suggests.

The simplest option does not require pre-existing coherence regions. The basic idea is simple: radiation at visible light induces the transition $2H_2O \rightarrow H_3O_2^- + \text{dark proton}$ where water molecules are hydrogen bonded. If dark protons at magnetic flux tubes fuse to form dark nuclei, they liberate dark gamma rays. If they decay to ordinary photons with correct energy they induces further transitions which can decay to ordinary photons. If their energies are correct they induce further transitions $2H_2O \rightarrow H_3O_2^- + \text{dark proton}$ and EZ is generated as a nuclear chain reaction.

1. $H_{3/2}O$ is stoichiometric shorthand for hydrogen bonded $H_3O_2^-$ molecule forming a loosely bound lattice structure with lattice binding energy small compared to the molecular bond energies. A pair of hydrogen bonded water molecules forming $H_2O-H-O-H$ structure ("—" denotes for hydrogen bond) could suffer dark ionization by giving up dark proton so that $H_3O_2^-$ molecule is formed. The dark proton would be transferred to the dark magnetic flux tube. The bond energy of O-H bond is 5.15 eV (https://en.wikipedia.org/wiki/Bond-dissociation_energy) is in the first approximation the net energy needed to transform $2H_2O$ to $H_3O_2^- + \text{dark proton}$ directly. This corresponds to UV energy. This is of course extremely rough estimate.
2. The objection is that the large negative electronic charge gives the system very large Coulomb energy so that it explodes. A possible manner to circumvent the problem is that dark protons fuse to dark nuclear strings and liberate nuclear binding energy, which compensates the Coulombic energy and stabilizes the system. Dark nuclear fusion would liberate dark gamma rays decaying into ordinary photons. If the photons have energies in the range of visible and UV photons they

could generate more H_3O_2^- molecules and the generation of EZ could proceed as a chain reaction. Hence dark phase of protons would be generated spontaneously in accordance with NMP and the resulting phase would be stable. These photons can also induce dark ionization of other biologically important ions appearing as anions or cations.

Dark proton sequences could also transform more complex nuclei containing dark neutrons and in TGD framework also exotic nuclei with charged bonds between nucleons are possible. The transformation of dark nuclei to ordinary ones would provide a new mechanism of nuclear fusion producing various elements outside solar core. There is indeed evidence for bio-transmutations [3, 4]. I have discussed this possibility as a possible explanation of Lithium anomaly [32]. One can even ask whether the prebiotic life could have generated some of the needed atomic nuclei artificially!

3. Gel phase in Pollack's experiments could provide the dark magnetic flux tubes for protons. In experiments of Urey and Miller electric discharges accompanied by magnetic flux tubes would do the same rather than providing metabolic energy as one might also imagine. This could be tested by replacing electric discharges with gel in the analogs of Urey-Miller experiments. Lightnings would have the same role in the evolution of prebiotic life. Dark flux tubes might have been associated with the magnetic fields of Earth. The endogenous magnetic field from the experiments of Blackman [23] has value $2B_E/5$, $B_E = .5$ Gauss is the magnetic field of Earth.

Second option is that coherence regions of del Giudice are created first. A subset of -O-H bonds is first transformed near criticality by UV light with energies around 4.8 eV as coherence regions are formed. After that metabolic energy quantum kicks the molecules over the threshold for the formation of H_3O_2 and liberates about 2 eV per bond. The burst of these ~ 2 eV photons should have been detected so that this option is not plausible. There is also the problem due to the fact that too many O-Hs could be taken to the criticality and both -O-H bonds of given water molecule could be taken to criticality.

3.3.3 Could dark proton sequences at flux tubes form dark nuclei?

In TGD framework nuclei correspond to nuclear strings [32] consisting of strings formed from dark protons and neutrons. Neutrons and protons could even form their own dark strings. Therefore dark proton sequences could but need not to fuse to dark nuclear strings with some nuclear binding energy and liberate the nuclear binding energy in the process.

Suppose that the fusion can occur so that a dark proton created in dark ionization is bound to an already existing dark proton sequence representing dark nuclear string at magnetic flux tube. By a naive extrapolation the binding energy would be same as in ordinary nuclear physics and would be measured in MeV range assignable to gamma rays. This estimate is probably wrong. As already explained, the nuclear binding energy could more naturally behave as $1/h_{eff}$ - like Coulomb energy- and nuclear excitation energy spectrum would be naturally in bio-photon energy range. The situation could become analogous to nuclear fusion liberating large amounts of energy. This would conform with NMP and with the idea that formation of large h_{eff} phases occurs spontaneously.

In the case of linear structures containing -O-H sequences with small enough distance dark nuclear fusion can be imagined. Could the fusion occur at phyllosilicate surfaces and generate dark analogs of DNA codons as highly stable structures? Could the fusion occur as a chain reaction liberating large amounts of energy at biophoton energies and lead to a formation of dark proton sequences with some maximum length dictated by Coulomb repulsion?

Could DNA nucleotides associate with these dark codons? If O^- associated with phosphates inside cell nucleus can combine with ordinary protons the hydrolysis of DNA can occur inside nucleus. The pairing of DNA and dark proton sequence by connecting magnetic flux tubes could prevent hydrolysis.

One prediction would be that the negative charge of DNA (one units per single nucleotide) is screened by dark proton sequences in vivo in the scale of the system formed by DNA and dark proton sequence. Usually it is believed to be screened by Na^+ counter ions. If the distance between DNA and dark proton

sequences is large enough, a local screening by Na^+ counter ions can indeed occur. What happens inside cell nucleus is far from clear to me.

3.3.4 Could dark nuclei collapse to ordinary nuclei?

One can also wonder whether the phase transition $h_{eff} \rightarrow h$ could produce ordinary nuclei and liberate energy in nuclear energy range. Could living matter be at criticality against nuclear explosion? The occurrence of bio-transmutations has been indeed claimed [3, 4]. This possibility would mean a manner to generate both nuclear energy and generate artificially those elements, which are depleted.

The observation that the isotope ratios reported to appear in the cold fusion experiment of Andrea Rossi are the natural ones (http://en.wikipedia.org/wiki/Rossi_Reactor) has been used to claim that the E Cat reactor developed by Rossi [2] is fraud. Lithium anomaly however forces to ask how large fraction of ordinary matter emerged via dark fusion in interstellar space, and how large fraction was generated in the stellar cores. Could even the fusion in stellar cores have occurred as dark fusion at magnetic flux tubes followed by a phase transition to ordinary matter?

One can argue that since the increase of h_{eff} and generation of negentropic entanglement (NE) occurs spontaneously, the fusion to ordinary nuclei must be a rare process. NMP suggests strongly that the existing NE must be transferred from the dark nucleus - magnetic flux tube - shortening to ordinary nuclear string in $h_{eff} \rightarrow h$. If this NE is associated with the transversal flux tubes connecting dark protons of the nuclear string with other similar system, the transfer could take place by reconnection of flux tubes with those of second analogous system (the model for DNA as TQC assumes that flux tubes connect dark protons assignable to DNA codons and lipids of nuclear/cell membrane [28]). The transfer of single transversal flux tube connecting A and B to that connecting C and D would require two reconnections: $AB + CD \rightarrow AC + BD \rightarrow AB + CD$. CD would have no NE in the initial situation and would have that of AB in the final situation whereas AB would have no NE. The probability that all flux tubes are doubly reconnected within a reasonable time span is expected to be small and only light nuclei might be generated. The occurrence of biofusion however suggest that this objection might be circumvented in some quantum critical situations.

3.3.5 Decay of very energetic dark photons to low energy photons

It is known that X and gamma rays accompany lightnings (<http://physicsworld.com/cws/article/news/2013/apr/17/dark-lightning-sheds-light-on-gamma-ray-mystery>). This is impossible in standard physics since X and gamma rays should be absorbed in atmosphere. I have proposed that that this radiation as also the radiation at lower energies propagates along magnetic flux tubes as dark photons.

Suppose that dark proton sequences indeed fuse to dark nuclei and liberate large amount of energy in the process as dark analogs of gamma rays but possibly much lower energy in the energy range of dark bio-photons and possessing much longer wave-length than usually. These dark photons can decay to ordinary photons and an interesting possibility is that this range includes visible photons (bio-photon energy range is a good in lack-of-anything-better-guess).

Could this decay promote the visible light promoting the generation of EZ? If this were the case the formation of living matter could take place as a chain reaction as NMP encourages to think. Similar chain reaction could have taken place also in prebiotic circumstances, where lightnings could have provided the initiating photons and perhaps also dark photons in dark nuclear binding energy range decaying to visible photons initiating the process. Same could have happened in Urey-Miller experiments.

3.3.6 Anomalies possibly related to EZs

There are several anomalies which might allow explanation in terms of EZs.

1. Tesla studied what happens in di-electric breakdown and was perhaps the first experimentalist to discover dark matter. Critical phenomenon is in question and could in TGD Universe be accompa-

nied by the formation of dark matter - perhaps even dark nuclear matter accompanied by liberation of energy. Also dark radiation with wavelengths proportional to h_{eff} making possible long range communications and energy transfer could be involved [40]. The most fascinating phenomenon reported by Tesla was charge separation in length scales much longer than one might have expected and could directly reflect the generation of dark charged particles.

2. The article of Kanarev and Mizuno [7] reports findings supporting the occurrence of cold fusion in NaOH and KOH hydrolysis. The situation is different from standard cold fusion, where heavy water D_2O is used instead of H_2O . I have considered this finding in [32]. Obviously the mechanism generating dark proton sequences as dark nuclear fusion could explain the findings of Kanarev and Mizuno.
3. The irradiation of salt water with microwaves induces the "burning" of water with a visible flame [5]. The phenomenon is believed to involve the breaking of salt water into oxygen, hydrogen and salt. If EZ is formed this could mean formation of $H-O-H-OH_2 \rightarrow H_3O_2^- + \text{dark proton}$. Nuclear fusion need not be initiated since polymer structures are absent. The burning process could be induced by microwaves accompanied by dark photons having energy in the energy range of UV photons and transforming to UV photons.
4. Free energy anomalies are not taken seriously by the main stream since they are not consistent with energy conservation in standard physics framework. I have proposed they they could be understood in terms of generation of dark proton sequences and cold fusion liberating energy [43].

The so called Brown gas [8] (might be same as fourth phase of water) produced from water by electrolysis is reported to be able to melt metals at much below the melting temperature. The explanation would be that the presence of metal initiates transition to ordinary nuclei liberating nuclear energy. The original explanation was quite not like this [43] although the energy was assigned with dark proton sequences. Another interpretation is that the process generating dark proton sequences continues.

5. There is also analogy of charged water clusters (EZs) with two poorly understood phenomena: steam electricity [9] (<http://www.esdjournal.com/techpapr/prevens/previndx.htm>) and waterfall ionization. Also thunder cloud charge separation and sonoluminescence might involve the formation of charged water clusters.

3.3.7 How biosystems could control protein dynamics?

Hans Frauenfelder et al propose a unified model of protein dynamics based on experimental findings [15]. The key proposal is that protein dynamics is slaved by the hydration shell and by the bulk solvent. The dynamics of master should be slower than that of slave. The conformational motions of proteins have time scale in the range 1 ns-1 s. The frequencies corresponding to the splitting of hydrogen bonds are above 10 THz and hence splitting dynamics is faster than protein dynamics. Therefore the claimed master-slave relation looks strange at the first glance. One can however think that the cleaving of hydrogen bonds defines the control dynamics as dynamics of switching and is much faster process than processes occurring between switchings. Changing the position of switch would correspond to a catastrophe in catastrophe theoretic formulation. The dynamics at a given sheet of catastrophe is indeed slow except at the critical lines defining its boundaries [1].

This suggests that various phases of water define environments for water controlling the behavior of proteins. Quantum phase transitions would put switches on and off. If the phase is hydrogen bonded water clathrate, the protein finds itself inside "ice" layer and cannot move. Protein unfolding proceeding as quantum phase transition would represent a basic example of this situation. When the hydrogen bonds disappear due to the melting of the EZ around protein by the splitting of protein-water and water-water hydrogen bonds, protein becomes able to change its conformation and protein un-folding can occur. The

"ice" layer around protein can melt by the feed of external energy at energies below metabolic energy quantum. This radiation could arrive as dark photons from dark magnetic body decaying into bunches of ordinary photons with same frequency and inducing fast melting of the entire layer. The bulk solvent could control large scale protein motions by changing the viscosity achieved by modifying the density of hydrogen bonds. Protein would move in the direction where the resistance is smallest.

In ZEO the reverse process would correspond to melting but in non-standard time direction. One can interpret the situation also in terms of consciousness theory. The period between folding and unfolding would define self and the control action would generate the time reversal of self.

But "who" is the master? In TGD framework it would be naturally the dark magnetic body containing at its flux tubes dark proton sequences associated with proteins. The motor actions of the magnetic body would induce those of proteins. The only condition is that the inherent protein dynamics is fast enough to follow the dynamics of the magnetic body. The fingerprints of biomolecules are in energy region .05-.25 eV (this is also the energy range for hydrogen bond energies) and the frequencies are above 10 THz. Therefore the time scales of protein dynamics would actually reflect those of dark magnetic body.

The modelling of protein folding as a random process in which system tries all options and ends up to the bottom of potential well representing the final configuration has problems: the basic paradox is that the folding should take extremely long time. If protein folding is macroscopic quantal self-organization process governed by NMP in present of large h_{eff} phases, these problems might be circumvented. Folding could to high extent reduce to the folding of the underlying magnetic flux tube structure: proteins would follow automatically if they are surrounded by the "ice" layer of ordered water.

3.3.8 Relationship to DNA as topological quantum computer hypothesis

DNA as topological quantum computer (TQC) hypothesis [28, 37] emerged roughly decade ago. The basic idea is that DNA and lipid layer of nuclear membrane are connected by magnetic flux tubes. Also connections to cell membrane and membranes of the other cells are in principle possible. The braiding of the flux tubes induced by the flow of lipid layer in liquid crystal (LC) state makes possible topological quantum computations. Similar topological quantum computations could be associated with the system formed by microtubules and axonal membranes.

A more general idea is that flux tubes are analogous to coordinate lines of 3-D coordinate grid forming a backbone of the organism [39] implying that the morphogenesis of magnetic body would induce that of visible part of organism. For instance, each DNA codon could be accompanied by flux tubes parallel to DNA plus flux tubes in two orthogonal directions perhaps connecting DNA to the lipid layers of nuclear membrane. The orthogonal flux tubes could emanate from the dark protons associated with the phosphates of the strands.

One can imagine several identifications for the particles involved with the topological quantum computation. The basic condition is that DNA codons or codewords are represented in terms of dark variants of some particles.

1. If one assumes that individual nucleotides (A,T,C,G) are involved, it is natural to assume that the particles involved correspond to these in 1-1 manner. The realization discussed in [28] assume that the codons correspond to the $2+2=4$ spin states of u and d quarks and anticodons to corresponding states for antiquarks. The quarks would be of course dark to avoid annihilation. One can also imagine realizations in terms of $3+1 = 4$ spin states of pairs electrons associated with a pair of flux tubes connecting DNA nucleotide and lipid layer.
2. If the codewords of the genetic code formed by three codons are taken as basic units then the states of the particles used must correspond to 64 DNA codons. RNA nucleotides and amino-acids could also involve analogous flux tubes beginning from the paired dark protons. The obvious choice at DNA end are those dark proton states, which correspond to 64 DNAs. At the lipid end the dark proton state would be fixed by base pairing condition.

An interesting question is whether phospholipid states can be said to be coded by DNA codons (surjective many-to-1 map of DNAs to lipid states). This question is quite general: is the possible DNA dark proton-biomolecule correspondence surjective so that genetic code would be much more general than thought.

Hu and Wu [26] have observed that proton pairs with members at opposite sides of cell membrane have spin-spin interaction frequencies in ELF scale. The TGD inspired the proposal [42] was that the protons are dark and form sequence at both sides of the lipid layer.