

More Precise TGD Based View about Quantum Biology and Prebiotic Evolution

M. Pitkänen

Email: matpitka6@gmail.com.

http://tgdtheory.com/public_html/.

October 18, 2015

Contents

1	Introduction	3
2	Background	6
2.1	About experimental work of Hans Geesink	6
2.2	Some theoretical ideas	6
2.2.1	Fröhlich's ideas	7
2.2.2	Forced coherence, coherence regions, and exclusion zones (EZs)	8
2.2.3	Water clathrates	8
3	Basic TGD based vision about quantum biology	9
3.1	How could external fields induce coherence?	10
3.2	Coherence regions and EZs	11
3.3	Quantum criticality bio-chemically	12
3.3.1	The role of fourth phase of water	12
3.3.2	Simplest model for the formation of fourth phase of water	13
3.3.3	Could dark proton sequences at flux tubes form dark nuclei?	14
3.3.4	Could dark nuclei collapse to ordinary nuclei?	15
3.3.5	Decay of very energetic dark photons to low energy photons	15
3.3.6	Anomalies possibly related to EZs	15
3.3.7	How biosystems could control protein dynamics?	16
3.3.8	Relationship to DNA as topological quantum computer hypothesis	18
4	Some phenomena discussed by Geesink from TGD view point	18
4.1	What phyllosilicates are?	19
4.2	Some effects	19
4.3	Plasma waves and acoustic oscillations	20
4.4	The transformation of dark photons to phonons and plasma oscillations	21
4.5	Why do phyllosilicates have positive health effects?	22
5	Basic TGD based vision about prebiotic evolution	22
5.1	Basic challenges	23
5.2	Are the abundances of biologically important ions consistent with their abundances in Earth's mantle?	24
5.3	The energetics of EZs	25
5.4	The role of phyllosilicates	25
5.4.1	A TGD inspired vision about the role of phyllosilicates	25
5.4.2	Adsorption of amino-acids and nucleic acids on phyllosilicates	26
5.4.3	Polymerization of bio-molecules	26
5.4.4	About the origin of phosphate	27
5.4.5	About the origin of cell membrane and cell	28

5.4.6	About the evolution of immune system	29
6	About evolution before Cambrian explosion	29
6.1	What happened before Cambrian explosion?	30
6.2	How the cellular life could have evolved before CE?	32
6.2.1	Basic classification of lifeforms	32
6.2.2	Prokaryote-eukaryote distinction	32
7	About possible practical implications	33
7.1	About predictions and implications	33
7.2	But what if silicate based life takes the lead?	33

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 (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 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. 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 *hydrogen bonded* $2H_2O \rightarrow H_3O_2^- + \text{dark proton}$ also other kind of dark ionizations. If the size of EZs varies from about 1 micron to 100 microns and if the the size scale of EZ corresponds to the wavelength of dark gamma photon h_{eff}/h varies in the range $10^6 - 10^8$. This would be the total number of dark photons resulting in the decay to ordinary photons. Water clathrates have same size scale range as EZs and consist of hydrogen bonded water molecules and could serve as precursors of EZs: EZ would have different lattice structure than clathrates.

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 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 hard to see whether TGD could allow to identify the common denominator of these approaches.

1. The works of Fröhlich [I9] and Del Giudice [I5] [D2] 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 [J3] 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 [I2] 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 $H_{3/2}$ 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 [I1] 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 [K4]. 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 $h_{eff} = h_{gr} = GMm/v_0$ [K19, K11] (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 [K15] 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 [I10], 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 $2\text{H}_2\text{O} \rightarrow \text{H}_3\text{O}_2^- + \text{dark proton}$ 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.

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 [I10], 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 [I10] 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 [K3].

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" [I10], 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 [I9] (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 [J2] 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 [K10].

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 unison 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 [J4] 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 [K5, K20]. 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 thee 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 [D2] [I5] 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 [?] It however turns out that one can do without coherences 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-superconductivity. 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 [I12] (<http://arxiv.org/pdf/1502.06880v2.pdf>). There are of course many views about quantum criticality: the characteristic difference between TGD inspired proposal [K18] 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 [I10] 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 importance 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 [I10] 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. Another option is based on the hypothesis that dark proton sequences are dark nuclei and their binding energy scales like $1/L$, L the size scale of dark nucleus measured in nanometers. If so, the binding energy of dark nuclei per dark proton would be in UV range. The process could proceed spontaneously as dark fusion. Dark proton sequences would be formed and emit UV photons with energy near 5 eV, which in turn would excite O-H near to the criticality so that a radiation with energy of energy near metabolic energy quantum can generate the dark proton and hydrogen bonded $H_3O_2^-$. Metabolic energy could induce this process.
4. 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 $-\text{O}-\text{H}$ to $-\text{O}^-$ 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?
5. 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?
 6. 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?
 7. 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.
 8. 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 [K1]. (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 [K20]. 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 [K19] 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* $2\text{H}_2\text{O} \rightarrow \text{H}_3\text{O}_2^- + \text{dark proton}$ 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 [K4]. 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 [C1, C2].

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 $\text{H}_{1.5}\text{O}$ 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 [I8] (<http://www.nature.com/nature/journal/vaop/ncurrent/full/nature14580.html>) supports this view [K19].

3.3 Quantum criticality bio-chemically

Quantum criticality [K18] 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 [K20]. 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 [I2] 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 [C1, C2]. I have discussed this possibility as a possible explanation of Lithium anomaly [K6]. 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 [J3] 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 [?] 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 [?] 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 [?]'s 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 [K2]). 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 accompanied 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 [K14]. 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 [D3] 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 [K6]. 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 [D1]. 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 $H-O-H-OH_2 \rightarrow H_3O_2^- +$ 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 [K17].

The so called Brown gas [H1] (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 [K17] 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 [H2] (<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 [16]. 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 [A1].

This suggests that various phases of water define environments for water controlling the behavior of proteins. If the phase is hydrogen bonded water clathrate, the protein finds itself inside "ice" layer and cannot move. Protein folding 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 water. 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 presence 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.

The following considerations provide additional insights in the attempts to build a model for protein folding. There is a new observation [I4] (<http://phys.org/news/2015-10-discovery-protein-window-basi.html>) about protein folding process. During folding some proteins hold single building blocks in shapes that were thought to be impossible to find in stable form. Stable shapes contained some parts, which were trapped like mosquitos in amber.

A concrete TGD based model relies on the general ideas of TGD inspired quantum biology.

1. Biomolecules containing aromatic rings play a fundamental role. All DNA nucleotides contain them and there are 4 proteins, which also have them. trp and phe are of special importance and form a pair structurally analogous to a base pair in DNA strand. The rings are assumed to carry the analog of supra current and be in or at least be able to make transition to a state with large $h_{eff} = n \times h$. The delocalization of electron pairs in aromatic ring could be a signature of $h_{eff}/h > 1$.
2. trp-phe pairing would be responsible for information molecule-receptor pairing. Information molecule and receptor would be at the ends of flux tubes serving as communication lines, and the attachment of info molecule to receptor would fuse the two flux tubes to longer one. After that communication would become possible as dark photon signals and dark supra currents. Formation of info molecule-receptor complex would be like clicking icon generating a connection between computers in net. Info molecules would generate the communication channels - they would not be the signals. This is the distinction from standard neuroscience.
3. All quantum critical phenomena involve generation of large h_{eff} phases. Folding emerges or disappears at quantum criticality (QC) possible in certain temperature range of width about 40 K and depending on pH. The flux tubes associated with phe and trp containing aromatic rings carrying “supra current” would become dark (either $h \rightarrow h_{eff}$ or $h_{eff} > h$ increases) and thus much longer and reconnect temporarily and force phe and trp in a close contact after the reverse transition inducing shortening. This is a general mechanism making biomolecules able to find each other in what looks like molecular soup in the eyes of standard biochemist. The contacts between amino-acids phe and trp formed in this manner are structurally identical with the hydrogen bonding between members of DNA base pairs and they would fix the final folding pattern to high degree.

There was also a very interesting article [I11] (https://www.researchgate.net/publication/14000528_Coherent_topological_phenomena_in_protein_folding) about possible topological phenomena related to protein folding. Authors are Henrik and Jakob Bohr (akin to Niels Bohr?) and Sören Brunak.

The article explains the basic topological concepts like winding possible involved in protein folding in a simple manner. The proposal is that the excitation of so called wringing modes of

proteins are involved in the generation and disappearance of the protein folding. Excitation of wringing modes twisting the protein (think about how one wrings water from a wetted cloth) would make the protein folding state *cold denatured* (CD) unstable and transform in to a stable *folded* (F) state. In the same manner their excitation would transform *hot denatured* (HD) stable state to a *folded* (F) state. Wringing modes could be excited by radiation.

In TGD framework the folding phase diagram CD-F-HD could be understood also in terms of QC. Perhaps the simplest option is that the transitions CD-F and HD-F involve a generation of critical states leading to a generation of long range correlations (large h_{eff}) inducing the folding pattern. Absorption of photons to wringing modes would induce the criticality and the folding would proceed by the mechanism discussed above.

3.3.8 Relationship to DNA as topological quantum computer hypothesis

DNA as topological quantum computer (TQC) hypothesis [K2, K12] 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 [K13] 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 [K2] 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 [J6] 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 [K16] was that the protons are dark and form sequence at both sides of the lipid layer.

4 Some phenomena discussed by Geesink from TGD view point

In the sequel some of the numerous phenomena discussed by Geesink are considered from TGD point of view with emphasis on phyllosilicates and possible mechanism behind their positive health effects.

4.1 What phyllosilicates are?

Silicate minerals (https://en.wikipedia.org/wiki/Silicate_minerals) constitute approximately 90 per cent of the crust of Earth. Quite generally, these minerals contain Si, O and almost any other element typically serving the role of cation in covalent bond. One can get an idea about the valence bond structure of the silicate mineral by using the familiar octet rule demanding full shells for anions. Typically one has SiO_4^{-4} tetrahedra as basic anion connected to 4 cations - in particular Si which can serve as both cation and anion. Note that for purely geometric reasons tetrahedra cannot form an infinite sized regular crystal. Quartz obeying chemical formula SiO_2 is the most well-known and simplest silicate mineral. There exist 6 different groups of silicate minerals and phyllosilicates are one of them.

Phyllosilicates (<https://en.wikipedia.org/wiki/Category:Phyllosilicates>) are sheet silicates formed from parallel sheets of silicate tetrahedra with Si_2O_5 . All phyllosilicate minerals are hydrated with either water or hydroxyl (O=COH) groups attached. This makes them biologically especially interesting. There are four groups of them: serpentines, clays, micas, and chlorites (“chlorite” has nothing do with Cl). The characteristic property is -O-H group and is expected to be of special interest biologically. There are also other silicate minerals which can contain -O-H groups but only phyllosilicates contain them always.

One highly interesting property of phyllosilicates is that they are natural semiconductors. Semiconductors or even semi-superconductors are highly interesting biologically: consider only the pioneering work of Becker with DC currents [J2] discussed in [K8] and the recent work of Bandyophay’s group with microtubular semiconduction [J5, J1]- or maybe even “semi-superconduction”) discussed in [K10, K13].

Geesink et al have used various dopands on silicate semiconductors and have found that the dopand ions have characteristic biological roles. Frequency mapping of the silicate semiconductors is carried out, and even storing frequencies to semiconductor materials has been found to be possible. This brings strongly in mind the work of Cyril Smith [I13] and the notion of water memory based on frequency storage discussed in [K4]. Also the presence of cyclotron frequencies associated with the “endogenous” magnetic field $B_{end} = .2$ Gauss first discovered by Blackman [J3] and other pioneers of bio-electromagnetism (discussed in [K7]) has been found and also evidences for multiples of basic frequencies coming as powers of 2 and 3 suggesting that the Pythagorean scale coming as quints (powers of 3/2 projected to the basic octave) might be fundamental in biology as proposed in the model of harmony in 12-note scale generalizing to a model of genetic code and suggesting that the 3-chords of so called bioharmonies with 64 basic chords are fundamental in living matter and realized also in terms of dark photons [L1] [K9].

4.2 Some effects

Many of the effects listed by Geesink have not caught my attention and it is interesting to look whether they might allow to sharpen TGD based vision discussed above.

1. Phyllosilicates are natural semiconductors and reported to be able to store frequencies, which brings in mind water memory [K4]. Cyclotron frequencies assignable to magnetic field strength .2 Gauss are assigned with them and Geesink claims evidence for a Pythagorean spectrum of frequencies coming as power of 2 and 3 multiples of the fundamental frequency.
2. Phyllosilicates generate also THz/microwave radiation having biological effects. Frequency matters instead of amplitude, which is very weak. Thus the effect looks quantal. There are both frequency, temperature, and amplitude windows. The energies of this radiation are below thermal energy so that one encounters what might be called kT - paradox if one wants to understand the effects quantally.
3. Phyllosilicates are used in a form of cation exchanged silicate sheets as catalysts, which suggests that they might act also as prebiotic catalysts. They are also used in nano-technology as nano-materials, nano-wires and patterned surfaces in nano-biological devices. Andrew Adamatsky has developed a model of cellular automation based on oscillators in phyllosilicate excitable automata [I3] (<http://arxiv.org/pdf/1305.0969v1.pdf>).

This dark irradiation could induce plasma oscillations with electron density of one electron per volume with scale of about 1 Angstrom perhaps applying in the case of EZs giving frequency $\asymp 9$ THz, which corresponds to .03 eV slightly below the thermal energy and the energy of cell membrane Josephson junction. It could also induce transitions between Rydberg states possibly present in living matter. For hydrogen atom THz radiation would induced transitions between states with principal quantum numbers $n, n + 1$ for $n \geq 10$, which corresponds to atomic radius about 10 nm, cell membrane thickness. THz/microwave radiation could also induce transitions of proteins and interaction with water clathrates.

TGD based explanation would be based on following basic ideas.

1. Quantum criticality occurs only for some critical ranges of parameters and could provide a generic explanation for the amplitude and temperature windows. Frequency windows in the case of cyclotron frequencies could be due to the windows for magnetic field strengths due to quantum criticality with respect to the generation of supra currents.
2. Large h_{eff} radiation with quanta having energies above thermal threshold and frequencies in THz/microwave range would induce classical coherence at the level of visible matter. Weak external em signal generates coherence - classical and perhaps even quantum mechanical. One can ask whether the emergence of coherence in mechanical systems could be induced in this manner.
3. Bose Einstein condensates and super-conductivity are speculated to be present. In TGD framework it would be enough to have BE condensates for cyclotron radiation and that in coherent oscillation modes proposed by Fröhlich would not be necessary. A storage of metabolic energy to cyclotron Bose-Einstein condensates could take place.
4. The EZs of Pollack would have natural description in TGD framework and would be analogs of electron plasmas. The coherence regions proposed by Del Giudice have much weaker experimental status. One should understand the formation of EZs and how the water molecules make coherently a transition from $2\text{H}_2\text{O}$ to H_3O_2^- + dark proton in EZ, and how this state can be stable despite its large negative charge due to charge separation. If coherence regions exist it is natural to assume the they are precursors of EZs. To my opinion water clathrates are however more feasible candidates in this respect.
5. Phase transitions increasing h_{eff} by a power of 2 following by a compensating phase transition reducing h_{eff} back to 2 by increasing the p-adic length scale by the same power of 2 so that the expanded volume is not affected could create Rydberg states from states with low principal quantum number. The transition should respect rotational symmetries.

Davydov soliton propagating along protein as a kind of acoustic wave is classical candidate for biologically important excitation possibly coupling with THz/microwave radiation. Microwaves are strongly absorbed by atmosphere which would mean that they can be important only inside organisms whereas dark cyclotron radiation with EEG frequencies could have wave lengths of order Earth size scale or even large. Also the magnitude of quantum very small as compared to thermal energy.

4.3 Plasma waves and acoustic oscillations

Geesink emphasizes the importance of plasma oscillations in THz/microwave range [I10]. Plasma frequency is analogous to cyclotron frequency in that it that it is purely classical notion. The fact that they are longitudinal oscillations suggests that they are not so fundamental as cyclotron radiation although also now energies would be proportional to h_{eff} and could be in bio-photon range. The plasma frequency is proportional to $e \times \sqrt{n/m}$ and cyclotron frequency to eB/m . Also the appearance of electron density also implies that plasma oscillations are not so fundamental as cyclotron radiation. Also the appearance of electron density also implies that plasma oscillations are not so fundamental as cyclotron radiation. For water with 1 electron per two water molecules (EZ) one would obtain 2.4 THz frequency assuming density of water.

Plasma oscillations require the presence of ionic lattice characterize ordinary biomatter. For dark matter at flux tubes only 1-D lattice structure can be imagined. Plasma oscillations might

therefore belong to the classical part of the biophysics like biochemistry. They would be subject to control from magnetic body. Dark photons with energies above thermal threshold can induce plasma oscillations by inducing the plasma oscillations resonantly if h_{eff} has proper - rather small - value.

One of the open questions has been whether there are also the analogs of bio-photons in IR above thermal threshold. Cell membrane would radiate generalized dark Josephson photons with energies $E = \Delta E_c + E_J$. ΔE_c is difference between cyclotron frequencies associated with flux tubes at different sides of cell membrane and corresponds to an energy in visible-UV range if $h_{eff} = h_{gr}$ hypothesis [K19] holds true.

Typically the energy range would be that for cyclotron photons and in visible and UV but in special case one would obtain ordinary Josephson photons with energy spectrum $E = ZeV \sim Z \times .05$ eV just above thermal energy and frequencies about $(12 \times Z/h_{eff})$ THz. This is above THz/microwave region for ordinary value of Planck constant. Relatively small values of $h_{eff} = n \times h$ would give frequencies $f = E/h_{eff}$ in these regions. This part of the Josephson radiation from cell membranes acting as ordinary Josephson junctions and could induce plasma oscillations among other things.

Also the decay of dark photons to ordinary photons could be considered and is suggested by the n -sheeted covering of the space-time sheets associated with $h_{eff} = n \times h$. Therefore also energetic effects could below thermal energies could be achieved besides frequency based effects represented by the coupling with acoustic oscillations and plasma oscillations.

The description of plasmons in many-sheeted space-time of TGD Universe is a demanding challenge. Electrons of plasma wave correspond to different space-time sheets than the ionic lattice. Electrons experience the ionic em fields and the field created by electrons themselves at ionic space-time sheet through wormhole contacts to the space-time sheet of ions. Only the ions not screened by electrons contribute. The challenge is to understand how electrons are able move coherently. Does this require coherence in micron scale and is this coherence forced by the presence of dark matter? In any case, the fundamental description should be in terms of magnetic flux tubes and massless extremals (MEs, topological light rays). The usual description is an approximation obtained by lumping together the sheets of many-sheeted space-time to single sheet and describing the interaction of test particle with induced fields at space-time sheets using standard model.

4.4 The transformation of dark photons to phonons and plasma oscillations

The transformation of dark photons to dark photons and plasma oscillations could take place and transform macroscopic quantum coherence to classical coherence at the level of visible matter.

1. The transformation of both ordinary dark photons to dark phonons and maybe even dark plasmons can be considered. The dispersion relations in the case of phonons are of same form but velocities differ dramatically. Energy and momentum conservation plus gauge invariance fixes the transformation amplitude essentially uniquely. Simplest process is $2 \text{ photon} \leftrightarrow 2 \text{ phonons}$ such that phonons have in excellent accuracy opposite 3-momenta. The amplitude is in relativistic notation proportional to $k_\mu^1 F^{\mu\beta}(a) F_\beta^\nu(b) k_\nu^2 + (1 \leftrightarrow 2)$, here k^i denotes the momentum 4-vector of phonon and $F(a/b)$ denotes the electromagnetic field tensor assignable to the the photon a/b . Similar expression should apply in the case of plasmons.
2. Cyril Smith talks about what I see as different phenomenon in which low frequency em signal is transformed to high frequency signal with much lower frequency [I13] [K4]. A favored frequency ratio is reported to be $f_{high}/f_{low} = 2 \times 10^{11}$.

I have considered a TGD based description based on the transformation of dark photons with low frequency but high energy $E = h_{eff} \times f_{low}$ to ordinary photons having $E = \times f_{high}$ [K4]. Smith's findings suggest a favored value $h_{eff}/h = f_{high}/f_{low} = 2 \times 10^{11}$. Also bio-photons in visible and UV range would be ordinary photons resulting from dark photons in this manner. This suggests that the deeper description of the coherence is as quantum coherence induced by macroscopic coherence at the level of dark matter. Dark matter would control ordinary matter by forcing it to oscillate coherently.

3. Dark photons, phonons, plasmons, etc.. would appear at quantum criticality and this gives an important guideline in the attempts to construct models.

4.5 Why do phyllosilicates have positive health effects?

The article of Geesink contains a long list of positive health effects due to the presence of phyllosilicate minerals. Water clathrate structures are stabilized; formation of oligomers is catalyzed; silicate minerals have sequence-, regio-, and homochiral selectivity; they absorb nucleic acids on the mineral surfaces (prebiotic habitats); they catalyze vesicle formation; they protect DNA against X-ray and UV; they protect adenine exposed to gamma radiation.

1. The transformation of X-ray, UV, and maybe even gamma radiation (emitted in the possible formation of dark nuclear strings at magnetic flux tubes) to low frequency dark radiation at magnetic flux tubes and therefore having no direct interaction with DNA is one possible mechanism. Absorption of nuclei acids and catalysis of oligomers could be essential for the transfer of dark genetic code to ordinary RNA by pairing the flux tubes containing dark proton sequences with RNA sequence. This could be exchange of the dark proton flux tube. In the case of anionic structures this could be understood if fourth phase of water is involved as dark photons at the flux tubes of the magnetic body generated as the silicate mineral was formed.
2. The presence of say silicate minerals, also quartz, in living matter could strengthen the cyclotron resonances if weak for some reason - say by the interaction with man-made random radiation tending to destroy the effects of coherent behavior induced by dark photons. The magnetic body of the organism could be somehow damaged (health would be also health of magnetic body!) and unable to carry out the biocontrol. Phyllosilicates (for instance) would strengthen the dark photon radiation responsible for the control.
3. What about the positive biological effects of quartz crystals? Quartz does not have structural negative charge since it obeys effective chemical formula SiO_2 . As found, charge neutralization at the boundary of quartz crystal is still needed and O^- :s at the surface could be replaced with -O-Hs. The presence of EZs could induce the transition back to O^- and generate dark proton so that also now dark magnetic body, dark cyclotron radiation, and even the analogs of bio-molecules as dark protons sequences could be present.

The picture becomes more attractive if one assumes that silicate minerals are accompanied magnetic flux tubes carrying dark nuclei and representing prebiotic phase. Ordinary DNA, etc could have emerged as a more faithful representation of dark genetic code by EZ mechanism generating also magnetic body for DNA. Ontogeny recapitulates phylogeny principle applied to silicates and bio-molecules would suggest that silicate minerals interact with DNA via dark matter.

5 Basic TGD based vision about prebiotic evolution

The fact that phyllosilicates generated in the interaction of water and silicate minerals have positive health effects suggests that they have played an important role in prebiotic evolution. There is indeed a lot of evidence to this direction coming from other sources: phyllosilicates allow adsorption of nucleotides and amino-acids, favour their polymerization, and induce the generation of lipid vesicles serving as predecessors of cell nucleus.

My own highly non-orthodox proposal [K3] is that prebiotic and even biotic lifeforms evolved in underground oceans, where UV radiation meteoric bombardment was absent. They were burst to the surface of Earth in Cambrian explosion in rapid expansion of Earth (cosmic expansion should take place as rapid phase transitions instead of smooth expansion - this is consistent with the fact the sizes of astrophysical objects are not observed to steadily increase). Basalt would have provided the silicate minerals having also dark magnetic bodies in presence of water and EZs. Chondrites from outer space contain basic bio-molecules and Earth has been formed from chondrites: therefore basic biomolecules would have also been present.

One prediction relates to the question about how oil and coal were formed (<https://en.wikipedia.org/wiki/Petroleum>). Two competing theories about the origin exist (<http://www.livescience.com/9404-mysterious-origin-supply-oil.html>).

1. The dominating theory assumes a biogenic origin of petroleum and coal (<https://en.wikipedia.org/wiki/Petroleum>), and states that they are produced from the organic material at the surface of Earth. At the dry land peat is formed first and later transformed to coal under heavy pressure. Coal it is transformed to oil and transferred to towards surface of Earth. Analogous process process would have occurred at the bottom of ocean: organic material would have formed sediments and these lose gradually contact with oxygen. This would induce transformation to coal with a very slow rate. A strong support for biological origin is the presence of complex aromatic biomolecules such as porphyrins assignable to basic metabolic mechanisms - in particular photosynthesis.
2. Second theory assumes abiogenic (one might say geological) origin so that the term “fossil fuel” would not be appropriate. Methane and simple hydrocarbons would have been present inside the mantle. This kind of hydrocarbons are encountered in chondrites, which have probably served as building bricks of Earth. Methane appears also at other planets. The presence of complex biomolecules in oil is the problem of the abiogenic model, and one must assume that they appeared to the oil as it was in contact with ordinary biological matter.

This model however provides a more convincing explanation for the isotope ratios of oil than biotic theory. The ratios would correspond to those in magma and chondrites and also metallic and isotopic compositions are explained (at the surface of earth interaction with cosmic rays affects the ratios so that one can distinguish between the two models). Also the presence of He can be explained. The model also predicts that oil and coal fields are large scale structures and oil and coal should appear also in non-sedimentary rocks. These predictions are correct.

Both theories have strong and weak points and both mechanisms might be involved. TGD suggests a modification of the abiogenic theory. Petroleum and coal could be produced from prebiotic and even bacterial lifeforms living in the mantle and their presence could explain the origin of the oil and coal at least partially. This would resolve the problem of both options. Of course, both this and standard mechanism could be involved.

5.1 Basic challenges

The concretization of this vision involves several challenges.

1. One must find whether the abundances of biologically important elements in Earth’s mantle are consistent with those in living matter. This will be discussed later.
2. Electric discharges were present in Urey-Miller experiments. What could have been their function? The first guess is that they provided energy. Second guess is that they provided (also) magnetic flux tubes for dark protons to be transferred to form dark nuclei. Did lightnings serve the same function during prebiotic era? Did gel phase in Pollack’s experiments perform the same function. Of course, lightnings could have provided also the UV light initiating the chain reaction generating EZ.
3. Ordinary solar radiation would have been absent. What served as the source of metabolic energy? How photosynthesis could have emerged? There are several options that one can consider.
 - (a) The key observation is that the recent temperature in Earth’s core is near to the metabolic energy quantum: .44 eV. The temperature of solar radiation about .58 eV! Could prebiotic life have emerged near the core and emerged to the surface in volcanic eruptions? Could dark photons from the core been able to propagate to underground oceans and provide the metabolic energy inducing the formation of EZs? Could highly developed lifeforms able to carry out photosynthesis have burst to the surface of Earth in Cambrian explosion?

- (b) Dolar radiation transformed to dark photons in the EZs associated with the water clathrates in atmosphere and propagated along dark flux tubes to the underground oceans.
 - (c) If the generation dark nuclei liberated binding energy at bio-photon energy range, dark nuclear energy could have made prebiotic life independent of external energy sources.
4. Atmosphere would have been absent. This need not be a shortcoming: there would be no UV radiation and no meteoric bombardment. In the experiments of Miller utilizing simple precursors like NH_3, CH_3 in presence of water and simulated lightnings reducing atmosphere was essential for obtaining amino-acids in experiments (<http://cdn.intechopen.com/pdfs-wm/38858.pdf>). Adenine, which is building brick of ATP, was formed when a system consisting of HCN and NH_4OH and montmorillonite was exposed to electric discharge. It is now however thought that the atmosphere was oxidizing, which supports the view that prebiotic life developed underground.

Could an environment containing water and phyllosilicates have provided the counterpart of reducing atmosphere? Wikipedia tells that reducing molecule in reaction donates electrons and oxidizing molecule receives them. (<https://en.wikipedia.org/wiki/Redox>). Basic biologically important atoms (H,K,Na,Ca,Mg) are electron donors and reducers and Cl is oxidizer. In oxygen rich atmosphere Oxygen is oxidizer. For instance, montmorillonite contains all above mentioned reducing ions. Maybe phyllosilicates could provide the counterpart of reducing atmosphere their de-adsorbtion from the mineral surface in atomic form occurs with a considerable rate.

5.2 Are the abundances of biologically important ions consistent with their abundances in Earth's mantle?

One possible objection is that the abundances of various biologically important molecules are different in the Earth's crust and in (say) human body (<http://hyperphysics.phy-astr.gsu.edu/hbase/tables/elabund.html>). The average abundances of carbon, nitrogen, carbon, sulphur, chlorine, phosphorus are considerably lower in the Earth's crust than in human body. These data are about Earth's crust. The problem disappears if the prebiotic evolution has taken place at special sites, perhaps even below crust.

1. Nitrogen is trace mineral in Earth's crust (3.3 per cent in human body). The low abundance is probably due to the degassing to the atmosphere. In mantle the concentration of nitrogen could have been much higher and in underground oceans a kind of nitrogen cycle might have been establishes. It is known that the N_2 in atmosphere originates from regions of the Earth where plates are converging. In Venus and Mars there is no plate tectonics and therefore a lack of N_2 . The obvious guess is that the rapid expansion of Earth radius by factor two generated the plates during Cambrian explosion and the nitrogen which was in underground oceans aqueous ammonium NH_4^+ was degassed (<http://www.nature.com/ngeo/journal/v7/n11/full/ngeo2271.html>).
2. What about carbon (.03 per cent in crust and 18.5 per cent in human body), which is also a key element of life. The positive surprise is that the vast majority of carbon resides in the deep Earth, below the surface, maybe 90 per cent of it. <http://www.livescience.com/29326-lava-linked-deep-carbon-cycle.html>. Most of carbon is in form of diamonds and not biologically interesting. There is however evidence that methane CH_4 is formed in the upper mantle 100-300 km below the 5-70 km thick crust (note that mantle is about 2900 km thick) (<http://www.nature.com/news/2004/040913/full/news040913-5.html>). This has inspired speculations about new sources of oil replacing the the fossil fuels. To me the more interesting possibility is that the life could have develop below crust.
3. One can worry also about Cl^- (0.01 per cent in crust and .2 per cent in human body). The web search suggests that the situation about the content of Cl^- in mantle is not settled. I also understood that the abundance of Cl^- is not constant in mantle. What comes in mind that Cl^- is solved into the water reservoirs to form HCl. Cl abundance is higher in the oceans at the surface of Earth than elsewhere.

As already noticed, the proposed mechanism for the formation of EZs generates dark proton sequences having interpretation as dark nuclei. These could suffer dark beta decay to more complex nuclei and dark nuclei could transform to ordinary nuclei. There is evidence for bio-transmutations [C1, C2]. Could this allow the prebiotic life to generate some of the needed atomic nuclei artificially?

5.3 The energetics of EZs

The above described mechanism for the generation of EZs involves the creation of dark nuclei as sequences of dark protons liberating nuclear energy compensating for the electronic Coulomb repulsion can occur as a chain reaction if the distances of linear molecules containing -O-H structures have such distances that the dark nuclei can form. The liberated dark gamma rays should decay to bunches of ordinary photons inducing *hydrogen bonded* $2H_2O \rightarrow H_3O_2^- + \text{dark proton}$ and would care that the process continues as a chain reaction.

Contrary to the first guess, gel would not serve as an energy source but provide magnetic flux tubes at which the dark protons can condense. Also the electric discharges in Urey-Miller experiment would have this function. Lightnings are known to be accompanied by gamma rays and extremely energetic electrons. In TGD Universe this requires darkness and magnetic flux tubes. Same should be true also for electric discharges, which are indeed a critical phenomenon. Could the dark flux tubes associated with lightnings penetrate below the Earth's crust? There seems to be no obvious argument against this - the very definition of darkness suggests this.

The dark ionization of also other than -O-H bonds is possible in presence of EZ by the decay of dark gamma rays to ordinary photons and it is possible to generate dark variants of biologically important ions. One cannot however expect formation of the analogs of dark nuclei for sequences of heavier dark ions nor for dark electrons. They might be generated from phyllosilicates such as montmorillonite as dark ions. The presence of water could be enough for this.

5.4 The role of phyllosilicates

Phyllosilicates are formed in the weathering of volcanic glass and rocks. Water in contact with volcanic glass and rocks produces clay minerals. This could also occur also in underground oceans without the presence of the atmosphere. How phyllosilicates in presence of water (and generated by the presence of water from simpler minerals) might help to achieve during prebiotic evolution? It is known that phyllosilicates adsorb amino-acids and RNA and induce their polymerization. Montmorillonite induces also the formation lipid miscelles serving as predecessors of cell membranes.

5.4.1 A TGD inspired vision about the role of phyllosilicates

If TGD view is correct, phyllosilicates in presence of water and EZs plus metabolic energy source allowing their generation might have additional functions.

1. Phyllosilicates contain -O-H:s as a basic building brick and the transformation $-O-H \rightarrow -O^-$ plus dark proton is highly suggestive in the presence of EZs. This would help to generate dark proton sequences assignable to the boundaries of phyllosilicates providing the analogs of basic bio-molecules DNA, RNA, and amino-acids, and possibly realizing a very simple variant of genetic code in the sense that dark proton state correlates with the anion created.

The dark proton sequences would be probably rather boring if the spin state of dark proton correlates strongly with the site, where it came from. This mechanism is attractive because it would allow to understand the emergence of immune system as will be found. For weak correlation so that the phyllosilicate analog of genetic code would be very many-to-one large number dark proton sequences would be generated. If RNA/DNA/amino-acid can condense around the dark proton templates with a 1-1 correlation between nucleotides/amino-acids a much more richer variety of these polymers are obtained.

2. The interaction of phyllosilicates with EZs could provide the dark variants of the biologically important ions. Montmorillonite contains almost all biologically important ions except anion Cl^- and can also be doped by replacing $-OH^-$ with Cl^- .

3. The layers of phyllosilicates could define kind of semi-super-conductors and there could be Josephson junctions between the layers so that primitive version of cell membrane might become possible generating dark photons at Josephson frequencies ZEV/h_{eff} .
4. If the lipid miscelles can surround EZs emerged from water clathrates, DNA or its predecessor could be stable inside them, and one would have a predecessor of cell nucleus and even cell. EZ could also stabilize the organic phosphate PO_4^{-3} containing O= and appearing in DNA (only diphosphate $P_2O_7^{-4}$ containing 2 O=:s is usually stable).
5. In TGD framework chiral selection can be explained in terms of large h_{eff} scaling up the weak scale from 10^{-17} meters to even cell length scale for the dark variants of weakly interacting particles. This would allow to understand how the preferred chiralities of bio-molecules emerge. Quartz, which is the simplest silicate mineral is already chiral. Chirality might be transferred from the surface of the quartz crystal to that of dark DNA.

5.4.2 Adsorption of amino-acids and nucleic acids on phyllosilicates

One must take very cautiously the existing data about the adsorption of biomolecules on clay minerals. Probably water solutions are used but certainly not EZs of Pollack. Their use could change the situation completely. The experiments should be carried out in a situation in which coherence regions are generated (perhaps by electric discharges or spontaneously) and the analog of solar radiation provides the needed metabolic energy to generate EZs.

EZs could lead to the transformation $-O-H \rightarrow O^- +$ dark proton and assign dark proton sequences to phyllosilicate surfaces. After this DNA/RNA and amino-acid polymers could be formed through a kind of transcription process using dark proton sequences as template. One could say that dark proton sequence is “stolen”. If dark proton sequences “code” for phyllosilicate molecules in 1-1 manner, the resulting sequences could be rather simple. If the code is many-to-one as in the case of the ordinary DNA-amino-acid code, rather complex polymers could be obtained.

Hideo Hashizume summarizes the existing ideas and experimental knowledge about the role of clay minerals in the evolution of life in his book *Clay Minerals in Nature- Their Characterization, Modification, and Application*. The chapter *Role of Clay Minerals in Chemical Evolution and the Origins of Life* can be found in web ([http://www.intechopen.com/books/clay-minerals-in-nature-their-characterization-modification-and-application/role-of-clay-minerals-in-nature-their-characterization-modification-and-application](http://www.intechopen.com/books/clay-minerals-in-nature-their-characterization-modification-and-application/role-of-clay-minerals-in-nature-their-characterization-modification-and-application/role-of-clay-minerals-in-nature-their-characterization-modification-and-application)).

Concerning adsorption of basic biomolecules montmorillonite (<https://en.wikipedia.org/wiki/Montmorillonite>) and kaolinite (<https://en.wikipedia.org/wiki/Kaolinite>) $Al_2Si_2O_5(OH)_4$ are the most studied examples (<http://cdn.intechopen.com/pdfs-wm/38858.pdf>).

Montmorillonite has 2 tetrahedral sheets sandwiching a central octahedral sheet. Plate shaped sheets have average diameter around 1 micrometer. Chemically montmorillonite is hydrated sodium calcium aluminium magnesium silicate hydroxide $(Na,Ca)_{1/3}(Al,Mg)_2(Si_4O_{10})(OH)_2 \cdot nH_2O$ able to contain thus almost all biologically important ions. Cl^- is not included but can replace $(OH)^-$ in the hydroxyl site.

Adsorption of the free positively charged amino-acids aspartic acid, glutamic acid, and phenylalanine is reported to occur via cation exchange. Alanine, serine, leucine, aspartic acid, glutamic acid, phenylalanine adsorbed to H-montmorillonite occur by proton transfer. These amino-acids are either negatively charged or neutral. The adsorption of glycine and its oligomers occurred in Ca-montmorillonite Ca-illite and their adsorption increased with the length of oligomer.

5.4.3 Polymerization of bio-molecules

Thermal vents are promising places for prebiotic polymerization. Repeated wetting and drying at beach is known to promote polarization at the surface of Earth. Similar situation might be encountered also in underground oceans as a tidal effect.

What is known is about polymerization induced by phyllosilicates in absence of EZs?

1. The polymerization of peptides to give oligomers (same unit repeating) is observed. Also nucleotide polymers (RNA) are generated. In experiments leading to generation of RNA polymers a condensation of 5^{prime} -phosphorimidazolide obtained from RNA nucleotide by replacing O- in phosphor with carbon-5-cycle containing three nitrogens.

RNA world as a model for prebiotic evolution requires 40 monomers theoretically. 6-14 are obtained. The reason is that hydrolysis competes with polymerization. A possible manner to overcome the problem would be formation of EZs preventing hydrolysis.

Polymerization up to 55 units is however achieved in presence of montmorillonite using successive feedings of monomers as found by Ferris et al [I7] (<http://www.nature.com/nature/journal/v381/n6577/abs/381059a0.html>). Note however that at the surface of Earth montmorillonite is formed by the weathering of volcanic ash (<http://elements.geoscienceworld.org/content/1/3/145.abstract>): it is not clear whether it can be formed in underground oceans.

2. The polymerization of DNA has not been reported. The reason probably relates to the presence of high energy phosphate bond and to the instability of DNA in ordinary water. It would be interesting to see if the presence of gel, water and irradiation with light could induce DNA polymerization.
3. Riboses are sugars and basic building bricks of DNA and RNA. Sugars have formaldehyde $O=CH_2$ as a precursor. Clay minerals can catalyze formation of formaldehyde and stabilize it.

Concerning the polymerization of biomolecules EZs provide an attractive mechanism. First dark proton sequence correlating loosely with the sequence of phyllosilicates at the boundary of a sheet is generated. This would represent “mineral life”: something between mineral kingdom and living matter. After that the analog of transcription would occur: DNA-/RNA- or amino-acid sequence would be associated with this sequence. If the correspondence dark proton sequence \rightarrow phyllosilicate unit is very many-to-one, this could give richly structured biopolymers.

DNA and RNA are accompanied by dark proton sequence at flux tube. Could it be that DNA and RNA could be generated from their dark analogs in presence of P_i or PP_i and coherence regions plus radiation at energy near metabolic energy quantum? The hydrolysis of DNA could be prevented inside EZ perhaps enclosed inside lipid miscelle formed in presence of montmorillonite.

These considerations are of course very naive. I have not even mentioned that in biology polymerization is catalyzed by enzymes, also by their RNA counterparts. What the precise function of catalyst could be if EZs and dark proton sequences are present and the relevant processes occur at the level of dark proton sequences? Could the reaction occur as reconnections of magnetic flux tubes associated with domains of reacting molecules forcing the reactants to re-organize around resulting new magnetic bodies. Could catalysis involve the generation of intermediate magnetic flux tubes structures allowing to overcome potential barriers? Phyllosilicates are of course excellent candidates for prebiotic catalysts.

5.4.4 About the origin of phosphate

The phosphate group is in many ways important in living things. It is a component of energy-rich molecules, such as ATP and without phosphates there would be no metabolism in the form as we know it. Phosphate is an important structural component of nucleotides, which are the basic structural units of DNA and RNA. It is bound to coenzymes like NADP/NADPH involved in anabolic reactions (such as photosynthesis in plants and lipid synthesis in animals). It also forms part of the hydrophilic head of phospholipids in biological membrane. Where there is life there is also phosphate, one might say.

Pyrophosphate $PP_i=P_2O_7^{-4}$ obtained from P-O-P by adding $O=$ and two $-O^{-1}$:s to both phosphates. Pyrophosphate decays in presence of water to two HPO_4^{-2} so that $O=$ disappears. How could (<https://en.wikipedia.org/wiki/Pyrophosphate> be transformed to biologically two bioactive phosphates $O=(P-O-H)O_2^{-2}$ obtained by adding $O=$, $-O-H$ and to $-O^{-}$. This form of phosphate is needed to build up DNA/RNA, ATP and other phosphate compounds. Is the presence of EZ necessary to stabilize the double bond?

How high energy phosphate bond could be generated?

1. In presence of water $P_2O_7^{-4}$ suffers a hydrolysis to $2P_i$, where the standard notation $P_i = HPO_4^{-2}$ is used. What could happen in presence of EZ? The simplest guess is that the second $-O-H$ loses its proton as dark proton and that what is usually called high energy phosphate

bond is generated. High energy phosphate bond need not be the only bond of this kind also other “high energy bonds” are possible.

2. This picture is consistent with the fact that when ATP suffer hydrolysis to ADP+P_i or AMP+PP_i transforming O⁻¹ to -O-H. The energy released - metabolic energy quantum - in ATP→ ADP+P_i is the energy liberated when e proton attaches back to O⁻. The dark proton for single phosphate need not belong to a dark nucleus so that it is not at the bottom of potential well and dark proton can attach to O⁻. In case of DNA only ordinary protons could be attached to O⁻ if dark nucleus accompanies DNA polymer.
3. Phosphorylation and de-phosphorylation could be interpreted in terms of reconnection of flux tubes so that the dark proton associated with phosphate is transferred to the acceptor molecule. I have proposed that the deeper meaning of metabolism is transfer of negentropic entanglement (NE). The reconnection of flux tubes would transfer NE between ATP and third party to NE between acceptor molecule and third party.

Some facts about phosphate in relation to geology are in order.

1. Phosphate minerals (https://en.wikipedia.org/wiki/Phosphate_minerals) do not appear in crust. Apatite group consists of phosphate minerals having PO₄ and involves OH, Cl and F. It is one of the few minerals produced and used by biological systems and is used as fertilizer. Teeth and bones contain apatite. Apatite is not common in Earth’s crust. Phosphosilicates exist but are very rare in crust.
2. Phosphate can appear also in igneous rocks. <http://www.eoearth.org/view/article/172157/> <http://www.eoearth.org/view/article/153764/> . Jukka Keinonen has written a book titled *Biological Role of Inorganic Pyrophosphate*. He proposes that volcanic magma could act as a source of pyrophosphate PP_i. Which possesses the double bond and differs only that the protons lost in ionization are not dark.

The findings described by Keinonen raise the hope that water-phyllosilicate system could have utilized inorganic phosphate PP_i and other ions solved in underground oceans. The presence of EZs might have transformed the ordinary ionization of PP_i to dark ionization generating dark protons and perhaps inducing the transformation of PP_i to biologically active phosphate of DNA. The process would be essentially loading energy to give rise to the somewhat mysterious high energy phosphate bond characterizing ATP. In TGD picture also volcanoes could have made possible the bursts of life forms to the surface of Earth.

5.4.5 About the origin of cell membrane and cell

The presence of montmorillonite induces formation of lipid micelles - double layers assembling to vesicles. Hydrophobicity is the driving force and hydrophobic ends of the lipids in the bilayer are directed to the interior. The interior of vesicle would contain EZ generated from water clathrate, montmorillonite sheets, plus chemicals giving rise to the evolution of biomolecules. The stability of the fourth phase of water guaranteed by the cell membrane would prevent dehydration of DNA or of its predecessor.

During prebiotic evolution the DNA would have developed so that it would have correlated more and more strongly with the dark proton sequences defining the actual realization of genetic code. As already mentioned, the recent finding that so called knocked out genes are transcribed correctly [I8] (<http://www.nature.com/nature/journal/vaop/ncurrent/full/nature14580.html>) supports this view [K19].

Also lattices of phyllosilicate molecules at the surface and linear sequences at the boundaries of sheets could develop symbolic representations in terms of dark proton sequences if the state of dark proton correlates with phyllosilicate. These correlations could be also absent in which the random sequences of dark protons could serve as templates for the formation of complex DNA/RNA/amino-acid sequences. Same could happen also in the case of RNA and amino-acids. This could be seen as dark variant of ion exchange with ion now a dark proton. Phospholipid lattice of lipid miscell3 could be accompanied by flux tubes carrying dark protons perhaps forming dark nuclei and the liberated nuclear binding energy could have led to a chain reaction reactions the miscelles.

5.4.6 About the evolution of immune system

In [K4] I have considered a model for the evolution of immune system.

1. The prebiotic system can “direct attention” to invader molecule by forming reconnections with its magnetic body. The simplest manner to do this would be reconnection of U-shaped flux tubes serving as kind of tentacles to a pair of flux tubes connecting the it to the invader. The reconnection could form only if the magnetic field strengths are same so that prebiotic system should be able to vary the field strength by varying the flux tube thickness - kind of motor action of the magnetic body. This would allow for the prebiotic system to get information about the magnetic body of the invader molecule.
2. Dark proton sequences at the flux tubes associated with the invader would give rise to a representation about the negative ionic structure of the invader molecule if there is a correlation between ion and corresponding dark proton.
3. Suppose that the prebiotic system can learn this code by the mechanism of directed attention discussed - say by stealing pieces of the dark proton sequences in the magnetic body of the invader molecule! This would make possible to associated to this dark proton sequence an amino-acid sequence by a generalization of translation process proton sequences.
4. These proteins could attack the invader innocuous by attaching to it. Attaching would be the reverse form the transformation of say amino-acid to active state: $-O-H \rightarrow O^- + \text{dark proton}$. Protein would attach to invader molecule in this manner.

The processes $-O-H \rightarrow O^- + \text{dark proton}$ and its reversal would be fundamental processes making bio-molecules active in presence of EZs and would give to genetic code and translation and transcription processes realized at the level of dark proton sequences. The analog of ion change reaction for magnetic flux tubes would make it possible to “steal” the dark protons sequences and make the invader molecule innocuous and this would give rise to the development of immune system.

6 About evolution before Cambrian explosion

In the following I try to formulate a more detailed TGD inspired vision about how life might have evolved in TGD Universe during pre-Cambrian era before relatively rapid expansion of Earth size by a factor of 2 assumed in TGD versions of Expanding Earth model predicting that cosmic expansion takes place in given scale as rapid jerks rather than continuously as in ordinary cosmology. The key ingredients besides standard facts are TGD inspired interpretation for Cambrian Explosion (CE) [K1, I10], the vision about dark matter as large h_{eff} phases [K18], and the notion of magnetic flux tubes. These provide TGD view about Pollack’s Exclusion Zones (EZs, [I2]) as key factors in the evolution of life.

I have gathered useful links from web to build a more detailed version of TGD vision and it is perhaps appropriate to give a list of some useful links - they appear also as references. These links might help reader considerably in getting touch about the problems involved and reader can easily find more.

1. Data related to Mars

Two generations of windblown sediments on Mars:

<https://www.nasa.gov/content/two-generations-of-windblown-sediments-on-mars>,

Sedimentary Mars: http://science.nasa.gov/science-news/science-at-nasa/2000/ast04dec_2/ *Liquid flows in Mars today: NASA confirms evidence:*

<http://www.sciencedaily.com/releases/2015/09/150928094114.htm>

2. Metabolism

Microbial metabolism: https://en.wikipedia.org/wiki/Microbial_metabolism

Electron transport chain: http://en.wikipedia.org/wiki/Electron_transport_chain

Metal-eating microbes in African lake could solve mystery of the planet’s iron deposits:

<http://www.sciencedaily.com/releases/2015/09/150909125005.htm>

3. When did photosynthesis emerge?

Ancient rocks record first evidence for photosynthesis that made oxygen

<http://www.sciencedaily.com/releases/2015/10/151006192107.htm>

Cyanobacteria: <https://en.wikipedia.org/wiki/Cyanobacteria>

4. When did oxygenation really occur?

Great Oxygenation Event: https://en.wikipedia.org/wiki/Great_Oxygenation_Event

Mass-Independent Sulfur Isotopic Compositions in Stratospheric Volcanic Eruptions:

<http://www.sciencemag.org/content/315/5808/84.abstract>

Neoproterozoic carbonate-associated sulfate records positive $\Delta^{33}\text{S}$ anomalies

<http://www.sciencemag.org/content/346/6210/739.abstract>

Great Oxidation Event "a misnomer":

<http://www.abc.net.au/science/articles/2014/02/20/3948092.htm>

An Oxygen-poor "Boring" Ocean Challenged Evolution of Early Life

<http://ucrtoday.ucr.edu/12843>

5. The role of iron

Evidence for a persistently iron-rich ocean changes views on Earth's early history

<http://www.sciencedaily.com/releases/2011/09/110907132052.htm>

6.1 What happened before Cambrian explosion?

The story about evolution of life is constructed from empirical findings based on certain geological, chemical, and isotope signatures. The study of sediment rocks makes possible reasonably reliable age determinations but involves assumptions about the rate of sedimentation. Water, ice, acids, salt, plants, animals, and changes in temperature contribute to weathering and cause erosion involves water, ice, snow, wind, waves and gravity as agents and leads to sedimentation. Also organic material forms sediments both on land and at ocean floors.

Isotope ratios serve as signatures since they are different in inanimate and living matter because those for living matter reflect those in atmosphere and are affected by cosmic rays. The concentrations of various elements are important signatures: mention only oxygen, nitrogen, sulphur compounds such as sulphide, hydrogen sulphide. and sulphate iron, and molybden.

The story involves great uncertainties and should not be taken only as a story. In the following TGD view about how life evolved before Cambrian Explosion (CE) about .6 gy ago is summarized. The Pre-Cambrian part of TGD inspired story differs dramatically from the official narrative since only lakes would have been present whereas official story assumes oceans and continents. Earth would have very much like Mars before CE - even its radius would have been essentially same (half of the recent radius of Earth). This suggests that Mars could teach us a lot about the period before CE 1. The deviations seem to explain its paradoxical looking aspects of the standard story.

1. Life according to TGD evolved in underground oceans and at the surface of Earth containing lakes but no oceans. The lifeforms at the surface of Earth were prokaryotes whereas the life in underground oceans consisted of relatively complex photo-synthesizing eukaryotes.
2. The recent data from Mars 1 gives an idea what the situation at Earth was during CE since the radius of Earth at that time was very nearly same as that of Mars now. There is evidence for sedimentation and for water near to and even at the surface provided quite recently. The life at the surface of Earth before CE consisted mainly of prokaryotes and very simple mono-cellular eukaryotes and something like this is expected at the surface of Mars now.
3. Already around 3.5 gy ago prokaryotes using sulphate as energy metabolite were present. Photo-synthesizing cyanobacteria emerged about 3.2 gy ago 3. They became later the plasmids of plant cells responsible for photo-synthesis. The problem of the standard story

is that this did not lead to oxygenation of the hypothetical oceans and rapid evolution of eukaryotes and multi-cellulars.

In standard vision one can explain the absence of oxygen based life in hypothetical oceans by the presence of oxygen sinks. It is known that the ancient oceans (shallow oceans, lakes, or ponds in TGD) were oxygen poor and iron rich. The data about Mars 1 - the red planet because of iron rusting - makes possible to test the feasibility of this hypothesis. The oxygen produced by the cyanobacteria was used to the formation of rusted iron layers giving rise to iron ores. For 1.8 gy ago the formation of rusted iron layers ceased. A possible explanation is that all iron was used. The ores could have been also generated by bacteria using iron as metabolite 2 and transforming it to iron oxide. There are however now iron ores after 1-8 gy: did these bacteria lose the fight for survival?

In TGD Earth atmosphere remained oxygen poor since the small lakes could not produce enough oxygen to induce the oxygenation of the atmosphere. The lakes however gained gradually oxygen. First it went to the oxidation of iron.

4. A general belief has been that about 2.4 gy ago Great Oxidation Event (GOE) 4 occurred. The basic evidence for GEO is from volcano eruptions, which seem to have produced anomalously small amount of sulphur after 2.4 gy. The reason would have been the formation of sulphate SO_4 from atmospheric oxygen and sulphur emanating from volcano.

This evidence has been however challenged by measuring sulphur anomalies for recent volcanic eruptions. Their sign varies in time scale of month changing from positive to negative 4. It is quite possible that GOE is an illusion.

5. There is also problem related to to the “boring period” 1.8-8 gy. It seems that the hypothetical oceans remained still oxygen poor and iron rich 4. It has been also suggested that the boring period continued up to CE: the first animals after CE could have oxygenated Earth’s oceans 4. In TGD Universe GOE is indeed illusion for the simple reason that oceans did not exist! Life was boring at the surface of Earth from 3.5 gy to .6 gy.
6. Life would have evolved in underground seas containing oxygenated water, probably already 3.2 gy ago, and making possible photo-synthesis and cellular respiration. Animal cells formed by eukaryotes with nucleus carrying genome with prokaryotes, which later became mitochondria. Plant cells emerged when these eukaryotes engulfed also cyanobacteria, which made photo-synthesis possible. The highly developed eukaryotes were burst to the surface as the radius of Earth increased by a factor two in geologically short time scale. Oceans containing oxygen rich water were formed. CE can be equated with GOE in TGD picture.

Plants are divided into green and red algae, a small group of fresh water monocellulars glaucophytes, and land plants. Land plants must have emerged after CE. Red algae are multi-cellulars (corals are representative example). Also green algae can be multi-cellulars and land plants are thought to have developed from them. An interesting question is whether multi-cellular plants and animals emerged already before CE as the findings would suggest.

The basic objection against this vision is that photo-synthesis is not possible underground. Did photo-synthesis occur in shallow lakes storing chemical energy transferred to the underground seas. This does not seem a plausible option but cannot be excluded. The volcanoes and hydrothermal vents bring water from underground. The water contains ground water and ordinary sea water, which ended underground in various manners, and also magmatic component. The geothermal vents and most volcanoes are however associated with the regions where tectonic plates meet and should not have existed before CE.

TGD inspired model [I10] for Pollack’s EZs [I2] suggests a solution of the problem. The formation of these negatively charged regions of water is induced by solar radiation, IR radiation at energies which correspond to metabolic energy quantum, and also at energies corresponding to THz frequency. TGD based model proposes that the protons from EZ becomes large h_{eff} protons at magnetic flux tubes associated with EZ. These flux tubes could be quite long and extend to the underground oceans. Dark photons with energy spectrum containing that of bio-photons could travel along these flux tubes. This suggests that solar radiation transforms partially to dark

photons, which travel along flux tubes to the underground sea and transform to ordinary photons caught by photo-synthesizing cells.

Interestingly, also the temperature of Earth is such that thermal radiation would be in visible region and one cannot exclude the possibility that dark photons emerge also from this source. This would make possible also cell respiration and oxygen rich water.

Skeptic is of course wondering whether the flux tubes were long enough.

1. The basic idea about dark matter residing at magnetic flux tubes emerged in TGD from Blackman's findings [J3] about quantal looking effects of ELF em fields on vertebrate brain by assigning them to cyclotron frequencies Ca^{++} ions in endogenous magnetic field $B_{end} = .2$ Gauss, which is by a factor $2/5$ weaker than the recent magnetic field of Earth and assigning large non-standard value of Planck constant to the flux tubes so that the energies of ELF quanta are above thermal energies.
2. The value of magnetic field at flux tubes of "personal" magnetic bodies of organisms have B_{end} in its value spectrum. B_{end} could be conserved in evolution somewhat like the salinity of ancient (underground) ocean. The flux tubes of B_{end} would have transformed the photons of solar radiation to dark cyclotron photons allowing them to travel to underground sea and transform back to ordinary photons to be absorbed by pre-plant cells. I have proposed that a similar mechanism is at work in biological body and could explain the reported ability of some people to survive without any obvious metabolic energy feed.

6.2 How the cellular life could have evolved before CE?

In the following I summarize what looks the most plausible view about evolution of life in TGD framework. I represent first basic classification to make reading easier.

6.2.1 Basic classification of lifeforms

Lifeforms are classified into prokaryoties (no cell nucleus) and eukaryotes (cell nucleus).

1. Prokaryotes are mono-cellular and have no separate cell nucleus. They are divided into bacteria and archea. Bacteria do not have genome but only circular DNA strand and usually accompanied by an almost palindrome. Archea have also genes. Cyanobacteria are simplest photo-synthesizing cells: these prokaryotes have been engulfed by eukaryotes to form plant cells containing them as plasmids. Plant cells contain also mitochondria believed also to be ancient prokaryotes which have been "eaten" by eukaryotes. Plants cells contain both mitochondria and plastids whereas animal cells contain only mitochondria.
2. Eukaryotes have cell nucleus containing the genome. Eukaryotes divide into three kingdoms: animals, plants, and fungi. Fungi can be said to be between animals and plants: they do not perform photo-synthesis but have cell walls.

6.2.2 Prokaryote-eukaryote distinction

From the existing data one can conclude that during pre-Cambrian period only prokaryotes existed at the at surface of earth - presumably in small lakes in TGD Universe and ocean floors in standard Universe. The first photo-synthesizing prokaryotes - cyanobacteria - emerged about 3.2 gy ago and their predecessors where prokaryotes extracting metabolic energy from sulphate. Cyanobacteria 3 are able to survive in practically any imaginable environment:

Cyanobacteria are arguably the most successful group of microorganisms on earth. They are the most genetically diverse; they occupy a broad range of habitats across all latitudes, widespread in freshwater, marine, and terrestrial ecosystems, and they are found in the most extreme niches such as hot springs, salt works, and hypersaline bays. Photoautotrophic, oxygen-producing cyanobacteria created the conditions in the planet's early atmosphere that directed the evolution of aerobic metabolism and eukaryotic photo-synthesis. Cyanobacteria fulfil vital ecological functions in the world's oceans, being important contributors to global carbon and nitrogen budgets.

It is therefore natural to assume that cyanobacteria migrated to underground ocean through pores and fractures at the floor of lakes. They would have fused with pre-eukaryotes having

only cell nucleus but no metabolic machinery to become chloroplasts. This would have given rise to the first eukaryotes able to perform photo-synthesis. The primitive cells prokaryotes defining pre-mitochondria would have also fused with these pre-eukaryotes so that both pre-plant and pre-animal cells would have emerged. Why there is no evidence for the existence of pre-mitochondria as independent cells at the surface of Earth? Did they emerge first underground oceans, where photo-synthesis was not possible and disappeared in the fusion with pre-eukaryotes and therefore left no trace about their existence on the surface of Earth?

Both photo-synthesis and cell respiration involve so called electron transport chain (ETC 2) as a basic structural element. It is associated with any membrane structure and in photo-synthesis it captures the energy of photon and in cell respiration it catches the biochemical energy which could be emitted as photon so that the fundamental mechanism is the same. This suggests that cell respiration emerged as a modification of photo-synthesis at the level of prokaryotes first. Before the emergence of mitochondria and plastids ETC associated with pre-eukaryote membrane would have served the role of mitochondria or plastid. Using business language, mitochondria and plastids meant “outsourcing” of photosynthesis and cellular respiration.

7 About possible practical implications

The predictions and practical implications of the proposed vision - if correct - are probably obvious to the reader but deserve to be stated clearly.

7.1 About predictions and implications

The proposed vision sounds certainly totally crazy from the viewpoint of standard physics. There are several new notions forced by TGD: the notion of many-sheeted space-time leading to the notion of field/magnetic body as an intentional agent controlling biological body and receiving sensory input from it; quantum criticality explaining dark matter as large h_{eff} phases; ZEO and NMP in (only) apparent conflict with second law predicting the evolution occurs spontaneously.

The most counterintuitive predictions of TGD inspired biology are involved in an essential manner. In accordance with the observation that astrophysical objects do not themselves expand although they participate in cosmic expansion as comoving objects, cosmic expansion is replaced by sequence of rapidly occurring quantum phase transitions increasing the size of system by some factor - say two. This justifies Expanding Earth hypothesis and leads to the vision that life could have evolved underground. Second equally counterintuitive prediction is that life emerge as dark nuclear fusion spontaneously and led to generation of both biopolymers and lipid layers.

The model has however testable predictions. The experimental arrangement leading to the formation of EZs can be modified by introducing phyllosilicates and other biologically important biomolecules to see whether the presence of EZs leads to generation of more complex bio-molecules. The claims about biofusion could be also tested. There are connections with large number of anomalous phenomena - free energy and Brown gas, cold fusion, biological transmutations, boiling salt water, etc... and TGD based explanation could be tested. For instance, biofusion of various light elements could lead to problems with radioactive dating since the ages of samples would have tendency to be too short. In the case of radiocarbon (C_{14}) dating this problem is indeed encountered and one performs a correction (https://en.wikipedia.org/wiki/Radiocarbon_dating).

It is also easy to imagine far reaching technological implications.

1. Dark fusion followed by a phase transition to ordinary matter could make possible artificial generation of elements. The technological significance for the world in which various resources are rapidly depleting would be immense.
2. The possibility to generate artificial silicate-based intelligent lifeforms of course comes first in mind but involves rather obvious dangers.

7.2 But what if silicate based life takes the lead?

I do not take seriously the claims of the proponents of strong AI that computers could take power over humans. Strictly classical computers are zombies and incapable of any intentional behavior.

Their real life variants could possess some kind of primitive awareness but this consciousness would probably have very little to do with the program running in the computer.

Of course, computerization can be a real danger to humankind even if computers are for all practical purposes intentionless zombies. Indeed, many leading AI professionals together with Hawking (<http://www.theguardian.com/technology/2015/jul/27/musk-wozniak-hawking-ban-ai-autonomous-weapon>) have signed an open letter warning about the dangers of military AI. The military applications of computers are developing rapidly and are rather frightening. Already now military professionals talk about information war and suggest that also Finland should take active attitude: not only defense but also attack. Many professionals believe that systems attacking living targets will be realized within few years. Systems, which behave autonomously and can select their targets, could lead to catastrophe, when their control breaks down. This would be third revolution in warfare after gunpowder and nuclear weapons and those who know should do all that they can to prevent the AI arms race.

I understand that the fusion of biosystems and computers via interfaces consisting of phyllosilicates is also studied and this represent something, which is goes beyond the boundaries of AI. If the vision discussed in this work or some other vision has something to do with reality, they could lead to a development of artificial life forms with conscious intelligence. The recipe would be rather simple: water+ silicates+ something, which could be gels and visible radiation or electric discharges. Silicon would be only replaced with silicates.

These kind of systems could act as intelligent and conscious interfaces between humans and computers. AI specialist could give probably give a long list of other applications. It would be very handy if they could replicate and evolve (by NMP in TGD framework) and this would be one of the goals of R&D activity. They should be also capable of simple intentional behaviors - also by NMP. Presumably we would couple them to world wide web.

But what happens if these local intelligences manage to make a phase transition to a collective intelligence with world wide nervous system that we have generously built for them. NMP suggests that this kind of awakening could occur! What would this magnificent conscious intelligence think about us? Would it regard us as rather primitive carbon based pre-silicate life forms and treat us as we treat what we call "lower" lifeforms - convenient sources of negentropic entanglement, nutrients? Or can we hope that they would tolerate us - NMP is nice principle but it does not guarantee this since it leaves for self to choose between good and evil!

If the hypothesis about generation of dark nuclei is correct then there is also a real danger that nuclear explosion is generated.

Acknowledgements:

I want to thank Hans Geesink for very inspiring email discussions.

REFERENCES

Mathematics

[A1] E. C. Zeeman. *Catastrophe Theory*. Addison-Wessley Publishing Company, 1977.

Particle and Nuclear Physics

[C1] C. L. Kervran. *Biological transmutations, and their applications in chemistry, physics, biology, ecology, medicine, nutrition, agriculture, geology*. Swan House Publishing Co., 1972.

[C2] P. Tompkins and C. Bird. *The secret life of plants*. Harper & Row, New York, 1973.

Condensed Matter Physics

[D1] Burning salt water. <http://www.youtube.com/watch?v=aGg0ATfoBgo>.

- [D2] E. Del Giudice and G. Preparata. Coherent dynamics in water as a possible explanation of biological membrane formation. *J. of Biol. Phys.*, 20:105–116, 1994.
- [D3] P. Kanarev and T. Mizuno. Cold fusion by plasma electrolysis of water. <http://www.guns.connect.fi/innoplaza/energy/story/Kanarev/codlfusion/>, 2002.

Fringe Physics

- [H1] M. B. King. Water Electrolyzers and the Zero-Point Energy. *Physics Procedia*. <http://www.sciencedirect.com/science/journal/18753892>, 20:335–445, 2011.
- [H2] T. V. Prevenslik. Bubbles and Steam Electricity. *ESD Journal*. <http://www.esdjournal.com/techpaper/prevens/previndx.htm>, 2013.

Biology

- [I1] Miller-Urey experiment. <http://en.wikipedia.org/wiki/Miller-Urey>.
- [I2] The Fourth Phase of Water: Dr. Gerald Pollack at TEDxGuelphU. <https://www.youtube.com/watch?v=i-T7tCMUDXU>, 2014.
- [I3] A. Adamatsky. On oscillators in phyllosilicate excitable automata. <http://arxiv.org/pdf/1305.0969v1.pdf>, 2013.
- [I4] A. E. Brereton and P. A. Karplus. Native proteins trap high-energy transit conformations. *Science Advances*. <http://advances.sciencemag.org/content/1/9/e1501188>, 1(9), 2015.
- [I5] Tedeschi Alberto Emilio Del Giudice, Paola Rosa Spinetti. Article: Water Dynamics at the Root of Metamorphosis in Living Organisms. *Water*. <http://www.mdpi.com/journal/water>, 2:566–586, 2010.
- [I6] Hans Frauenfelder et al. A unified model of protein dynamics. *PNAS*. <http://www.pnas.org/content/106/13/5129.abstract>, 106(13):5129–5134, 2009.
- [I7] J.P. Ferris et al. Synthesis of long prebiotic oligomers on mineral surfaces. *Nature*. <http://www.nature.com/nature/journal/v381/n6577/abs/381059a0.html>, 381:59–61, 1996.
- [I8] Y.R. Steinier et al. Genetic compensation induced by deleterious mutations but not gene knockdowns. *Nature*. [doi:10.1038/nature14580](https://doi.org/10.1038/nature14580), 2015.
- [I9] H. Fröhlich. Long-range coherence and energy storage in biological systems. *In J Quantum Chemistry*. <http://onlinelibrary.wiley.com/doi/10.1002/qua.560020505/abstract>, 2004.
- [I10] H. Geesink. Proposal for a quantum field theory about coherence concerning non ionizing radiation. <https://geesinkresearch.files.wordpress.com/2014/12/proposal-for-a-quantum-field-theory-about-coherence-concerning-non-ionizing-radiation2c-g.pdf>, 2014.
- [I11] S. Brunak H. Bohr, J. Bohr. Coherent topological phenomena in protein folding, 2015.
- [I12] S. Kauffman. Quantum Criticality at the Origin of Life. <http://arxiv.org/pdf/1502.06880v2.pdf>, 2015.
- [I13] C. Smith. *Learning From Water, A Possible Quantum Computing Medium*. CHAOS, 2001.

Neuroscience and Consciousness

- [J1] A. Bandyopadhyay. Experimental Studies on a Single Microtubule (Google Workshop on Quantum Biology), 2011.
- [J2] R. O. Becker and G. Selden. *The Body Electric: Electromagnetism and the Foundation of Life*. William Morrow & Company, Inc., New York, 1990.
- [J3] C. F. Blackman. *Effect of Electrical and Magnetic Fields on the Nervous System*, pages 331–355. Plenum, New York, 1994.
- [J4] L. Fantappie. *Teoria Unitaria del Mondo Fisico e Biologico*. Di Renzo Editore, Roma, 1942.
- [J5] A. Bandyopadhyay G. Ghosh, S. Sahu. Evidence of massive global synchronization and the consciousness: Comment on "Consciousness in the universe: A review of the 'Orch OR' theory" by Hameroff and Penrose. *Physics of Life Reviews*, 11:83–84, 2014.
- [J6] H. Hu and M. Wu. Action Potential Modulation of Neural Spin Networks Suggests Possible Role of Spin. *NeuroQuantology*. <http://cogprints.org/3458/1/SpinRole.pdf>, 4:309–317, 2004.

Books related to TGD

- [K1] M. Pitkänen. Dark Matter Hierarchy and Hierarchy of EEGs. In *TGD and EEG*. Onlinebook. http://tgdtheory.fi/public_html/tgdeeg/tgdeeg.html#eegdark, 2006.
- [K2] M. Pitkänen. DNA as Topological Quantum Computer. In *Genes and Memes*. Onlinebook. http://tgdtheory.fi/public_html/genememe/genememe.html#dnatqc, 2006.
- [K3] M. Pitkänen. Expanding Earth Model and Pre-Cambrian Evolution of Continents, Climate, and Life. In *Genes and Memes*. Onlinebook. http://tgdtheory.fi/public_html/genememe/genememe.html#expearth, 2006.
- [K4] M. Pitkänen. Homeopathy in Many-Sheeted Space-Time. In *Bio-Systems as Conscious Holograms*. Onlinebook. http://tgdtheory.fi/public_html/hologram/hologram.html#homeoc, 2006.
- [K5] M. Pitkänen. Negentropy Maximization Principle. In *TGD Inspired Theory of Consciousness*. Onlinebook. http://tgdtheory.fi/public_html/tgdconsc/tgdconsc.html#nmpc, 2006.
- [K6] M. Pitkänen. Nuclear String Hypothesis. In *Hyper-finite Factors and Dark Matter Hierarchy*. Onlinebook. http://tgdtheory.fi/public_html/neuplanck/neuplanck.html#nuclstring, 2006.
- [K7] M. Pitkänen. Quantum Control and Coordination in Bio-Systems: Part II. In *Bio-Systems as Self-Organizing Quantum Systems*. Onlinebook. http://tgdtheory.fi/public_html/bioselforg/bioselforg.html#qcococII, 2006.
- [K8] M. Pitkänen. Quantum Model for Bio-Superconductivity: II. In *TGD and EEG*. Onlinebook. http://tgdtheory.fi/public_html/tgdeeg/tgdeeg/tgdeeg.html#biosupercondII, 2006.
- [K9] M. Pitkänen. Quantum Model for Hearing. In *TGD and EEG*. Onlinebook. http://tgdtheory.fi/public_html/tgdeeg/tgdeeg/tgdeeg.html#hearing, 2006.
- [K10] M. Pitkänen. Quantum Model for Nerve Pulse. In *TGD and EEG*. Onlinebook. http://tgdtheory.fi/public_html/tgdeeg/tgdeeg/tgdeeg.html#pulse, 2006.
- [K11] M. Pitkänen. TGD and Astrophysics. In *Physics in Many-Sheeted Space-Time*. Onlinebook. http://tgdtheory.fi/public_html/tgdclass/tgdclass.html#astro, 2006.

- [K12] M. Pitkänen. Three new physics realizations of the genetic code and the role of dark matter in bio-systems. In *Genes and Memes*. Onlinebook. http://tgdtheory.fi/public_html/genememe/genememe.html#dnatqccodes, 2006.
- [K13] M. Pitkänen. Quantum Mind, Magnetic Body, and Biological Body. In *TGD based view about living matter and remote mental interactions*. Onlinebook. http://tgdtheory.fi/public_html/pdfpool/lianPB.pdf, 2012.
- [K14] M. Pitkänen. About Concrete Realization of Remote Metabolism. In *Bio-Systems as Conscious Holograms*. Onlinebook. http://tgdtheory.fi/public_html/hologram/hologram.html#remotetesla, 2013.
- [K15] M. Pitkänen. Are dark photons behind biophotons. In *TGD based view about living matter and remote mental interactions*. Onlinebook. http://tgdtheory.fi/public_html/pdfpool/biophotonslian.pdf, 2013.
- [K16] M. Pitkänen. Comments on the recent experiments by the group of Michael Persinger. In *TGD based view about living matter and remote mental interactions*. Onlinebook. http://tgdtheory.fi/public_html/pdfpool/persconsc.pdf, 2013.
- [K17] M. Pitkänen. Summary of TGD Inspired Ideas about Free Energy. In *TGD and Fringe Physics*. Onlinebook. http://tgdtheory.fi/public_html/freenergy/freenergy.html#freerg, 2013.
- [K18] M. Pitkänen. Criticality and dark matter. In *Hyper-finite Factors and Dark Matter Hierarchy*. Onlinebook. http://tgdtheory.fi/public_html/neuplanck/neuplanck.html#qcritdark, 2014.
- [K19] M. Pitkänen. Quantum gravity, dark matter, and prebiotic evolution. In *Genes and Memes*. Onlinebook. http://tgdtheory.fi/public_html/genememe/genememe.html#hgrprebio, 2014.
- [K20] M. Pitkänen. Unified Number Theoretical Vision. In *TGD as a Generalized Number Theory*. Onlinebook. http://tgdtheory.fi/public_html/tgdnumber/tgdnumber.html#numbervision, 2014.

Articles about TGD

- [L1] M. Pitkänen. Geometric theory of harmony. http://tgdtheory.fi/public_html/articles/harmonytheory.pdf, 2014.