Dark matter, Quantum Gravity and Prebiotic Evolution

M. Pitkänen,

September 30, 2020
Email: matpitka6@gmail.com.
http://tgdtheory.com/public_html/.
Recent postal address: Rinnekatu 2-4 A 8, 03620, Karkkila, Finland.

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Abstract

The ideas related to prebiotic evolution have developed rather rapidly after the discovery of the hierarchy of Planck constants around 2003 providing a general manner to understand living organisms as macroscopic quantum systems.

1. Magnetic body as carrier of dark matter realized as phases with non-standard value $h_{eff} = n \times h$ of Planck constant is the key concept in the developments and brings to the description of the living matter a third level besides organism and environment.This has led to developments in the model of EEG as communication tool between biological and magnetic body and led to the interpretation of bio-photons as decay products of dark EEG photons. Also bio-superconductivity is now reasonably well-understood and the model for cell membrane as Josephson junction is generalized to include cyclotron energy besides difference in Coulomb energy. Square root of thermodynamics inspired by Zero Energy Ontology suggests itself as a proper description of Josephson junctions defined by transmembrane proteins. The dark genetic code seems to have so strong explanatory power that it must be taken seriously.
2. Another thread of development relates to the ideas about hierarchy of Planck constants. The findings of Nottale suggest that planets correspond to Bohr orbits with gigantic gravitational Planck constant. It took quite a time to realize that the same predictions follow if h_{gr} is associated with pairs formed by microscopic systems and Sun and that in this case the values of h_{gr} could be identified with those of h_{eff}.
3. Already during first years emerged the idea that the Planck constant characterizes magnetic flux tubes connecting two systems and depends on the quantum numbers of the systems assignable to the interactions in question. Therefore one can speak also about h_{em} assignable to electromagnetic interactions. A vision developed stating that when interaction gets too strong, h_{eff} increases so that the perturbation series in powers of $1/h_{eff}$ converges and perturbation theory works. At space-time level this means non-determinism, which is key feature of the basic varioational principle: the space-time sheets connecting initial and final 3-surface at boundaries of CD are n-sheeted for $h_{eff} = n \times h$ and the sheets co-incide at ends.
4. The model of water memory and homeopathy has led to an evolution of ideas relating to the development of immune system and bio-catalysis. The latest steps of progress were induced by the realization that the replication of magnetic body could be behind that of DNA and cell, the discovery of fourth phase of water and exclusion zones (EZs) by Pollack et al, and by the observation that anomalously high gravimagnetic Thomson field implied by large value of gravitational Planck constant could explain the anomalously large mass measured for electronic Cooper pairs in rotating super-conductor.
5. Zero energy ontology (ZEO) and adelic physics emerged years after the writing of the first version of this chapter. Adelic physics provided a mathematical justification for the hierarchy of Planck constants and p-adic physics. ZEO led to a view about biological evolution as a "must" and reduced allowed to understand self-organization in terms of a new view about quantum measurement predicting time reversal in ordinary state function reductions.

The model for water memory and homeopathy is discussed and shown to lead to a general model for how immune system and bio-catalysis could have developed from their dark primordial versions, how dark proteins might have emerged as concrete representations for invader molecules making it possible to make the invader non-dangerous by attaching to its magnetic body, how DNA and genetic code could have emerged as symbolic representations for the magnetic bodies of invader molecules and later as symbolic representation of the magnetic body of the system itself. ZEO implies that actually time evolution of the magnetic body can be coded by DNA and protein folding could provide a concrete representation for this time evolution.

The vision is applied in various situations.

1. A model for proto-cell as EZ is discussed.
2. M. Root-Bernstein and R. Root-Bernstein proposed the rather brilliant idea that ribosome was the first self-replicator. The idea is discussed and compared to the TGD framework where the natural solution to all hen-egg problems of biology is provided by the predicted dark variants of the basic bio-molecules. The dark variants of replication, transcription, translation, and metabolism would have been part of the fundamental

physics and their chemical realizations would have emerged as a kind of shadow dynamics, mimicry.

3. RNA world has also the problem with phosphorylation crucial for metabolic machinery. Proteins are absent and ribozymes are catalysts formed from RNA but they catalyze typically only the reversal of phosphorylation.

   The challenge is to circumvent the problem and the proposal considered suggests that a molecule known as di-amido-phosphate (DAP) could have solved the problem. TGD based view is that both the cell membraneand all basic biomolecules could have emerged more or less simultaneously by pairing with their dark variants. Also the basic catalytic mechanisms would have been present at the level of dark matter as $h_{eff} = nh_0$ phases.

   Remark: If one wants to believe in a TGD variant RNA world, ZEO could come in the rescue. ZEO predicts time reversal in ordinary state function reduction. Could phosphorylation result as a time reversed process? This question is however not considered.

4. Evidence for life in a rather unexpected place - Venus - has emerged. The atmosphere of Venus shows signs of phosphine PH_3 - the analog of ammonium NH_3 -, which cannot be produced by inorganic processes. There are small amounts of phosphine in the Earth's atmosphere and has an organic origin. Same might be true in the case of Venus. Perhaps simple bacterial life is in question. Is it in the atmosphere or somewhere deeper in an open question. TGD based vision about quantum biology suggests several options.

   The most conservative option suggested by TGD relies on the analogy between H_2S and water. The magnetic body (MB) of H_2S realizing also dark variants of basic biomolecules could play the same role as the MB of water. First proto cell membrane would have formed and led to the development of O-S separation so that the interior of the proto cell would have consisted mostly of water allowing ordinary bio-molecules to evolve.

5. Multi-local viruses are mysterious from the point of view of ordinary biology. The DNA, RNA, and proteins of these viruses divides into segments located at different host cells and can self-assemble back to the ordinary virus. Various partitions of the virus are possible. TGD based view about space-time and quantum theory allows to understand these viruses as connected entities at the level of magnetic body (MB).

6. There is evidence for oil droplets as a primitive life form. The basic objection is that droplets have no genetic code and do not replicate. The TGD inspired model for dark nucleons however predicts that the states of dark nucleon are in one-one correspondence with DNA, RNA, tRNA, and amino-acid molecules and that vertebrate genetic code is naturally realized. The question is whether the realization of the genetic code in terms of dark nucleon strings might provide the system with genetic code and whether the replication could take place at the level of dark nucleon strings rather than droplets. TGD inspired quantum model of biology leads to a model for oil droplets as a primitive life form. In particular, a proposal for how dark genes could couple to chemistry of oil droplets is developed.

1 Introduction

The ideas related to prebiotic evolution have developed rather rapidly after the discovery of the hierarchy of Planck constants around 2003 providing a general manner to understand living orgnisms as macroscopic quantum systems.

1. Magnetic body as carrier of dark matter realized as phases with non-standard value $h_{eff} = n \times h$ of Planck constant is the key concept in the developments and brings to the description of the living matter a third level besides organism and environment [K16].

2. EEG and its predicted fractal variants have interpretation in terms of communication from biological body to magnetic body and as control of biological body by magnetic body [K4]. EEG photons are identified as dark photons and the energy spectrum of dark EEG photons is conjectured to correspond to that for bio-photons. Bio-photons would result in the transformation of dark photons to ordinary ones and their energy spectrum would directly reflect the spectrum of endogenous magnetic fields. If h_{eff} for given ion is proportional to its mass number, the spectrum of energies for bio-photons resulting from dark cyclotron photons is universal and does not depend on charged particle.

3. One can now understand the mechanism making Cooper pairs of bio-superconductors stable, possibly even above room temperatures. Also the understanding of cell membrane as Josephson junction has increased considerably. The recent view [K9, K4] is that generalized Josephson junction is in question. The Josephson energy identified as the Coulombic energy difference at two sides of the membrane is generalized by including also the difference of cyclotron energies. This contribution dominates, and this explains why the value of metabolic energy currency is roughly 5-10 times higher than the value of Josephson energy.

   One ends up with a model of transmembrane proteins as generalized Josephson junctions by taking a "square root" of the thermodynamical model meaning that Boltzman weights are replaced with their complex square roots. The chemical potential difference of thermodynamical model is replaced with the difference of cyclotron energies. Generalized Josephson energies correspond to the differences of cyclotron energies in the first approximation since Coulombic contribution is small. The communications to the magnetic body by dark photons rely on frequency modulation due to variations of membrane voltage, in particular those induce by nerve pulses.

4. The totally unexpected observation was that the states of dark protons forming dark nuclei as string like objects correspond in natural manner to DNA,RNA, aminoacids and even tRNA molecules and that vertebrate genetic code is realized naturally, led to the proposal that prebiotic life relies on dark nuclear physics [K25].

5. Taking seriously the findings related to water memory and homeopathy [I14, I15, I12, I22, I23] as well as the findings of Gariaev et al [I17, I29] has led to a further progress. In this framework water memory and homeopathy provide direct evidence for the role of dark proton sequences at magnetic flux tubes as prebiotic life forms. The preparation of the homeopathic remedy would induce evolutionary process leading to a generation of a population of regions of water mimicking the magnetic body of the invader molecule. The challenge is to identify these regions.

6. The understanding of negentropic entanglement as entanglement described by $n \times n$ unit matrix and by unitary matrix for entanglement coefficient allowed a more precise understanding of Negentropy Maximization Principle and led to the conjecture that n is nothing but the integer characterizing h_{eff}. NMP implies that Universe generates negentropic entanglement, "Akashic records", being analogous to huge library extending quantum jump by quantum jump. It is perhaps not an accident that in quantum computation entanglement matrix is unitary.

7. There was also another thread related to the ideas about hierarchy of Planck constants. The findings of Nottale suggest that planets correspond to Bohr orbits with gigantic gravitational Planck constant. It took quite a time to realize that the same predictions follow if h_{gr} is associated with pairs formed by microscopic systems and Sun and that in this case the values of h_{gr} could be identified with those of h_{eff}.

   Already during first years emerged the idea that the Planck constant characterizes magnetic flux tubes connecting two systems and depends on the quantum numbers of the systems assignable to the interactions in question. Therefore one can speak also about h_{em} assignable to electromagnetic interactions. A vision developed stating that when interaction gets too strong, h_{eff} increases so that the perturbation series in powers of $1/h_{eff}$ converges and perturbation theory works. At space-time level this means non-determinism, which is key feature of the basic varioational principle: the space-time sheets connecting initial and final 3-surface at boundaries of CD are n-sheeted for $h_{eff} = n \times h$ and the sheets co-incide at ends.

8. The findings of Pollack [L4] about exclusion zones and fourth phase of water meant a further breakthrough and led to the proposal that negatively charged exclusion zones (EZs) of water with $H_{1.5}O$ stoichiometry are accompanied by magnetic body carrying dark proton nuclei at the flux tubes. EZs are excellent candidates for primitive life forms and can be identified as the primitive life forms making possible water memory and homeopathy [K16], [L4].

9. The last step of progress relates to the proposal of Tajmar et al that gravimagnetic effect could explain the well-established anomaly relating to the measurement of the mass of Cooper pair in rotating super-conductor. The GRT prediction for the effect is however 28 orders of magnitude too small so that new physics would be needed. The Thomson gravimagnetic field is proportional to h^2 so that large value of Planck constant could explain the effect. The value can be estimated and it is of the order of 10^{14} as required! If it is equal to h_{eff} then the energy spectrum of dark EEG photons is that of bio-photons as conjectured earlier!

10. Zero energy ontology (ZEO) and adelic physics emerged years after the writing of the first version of this chapter. Adelic physics provided a mathematical justification for the hierarchy of Planck constants and p-adic physics. ZEO led to a view about biological evolution as a "must" and reduced allowed to understand self-organization in terms of a new view about quantum measurement predicting time reversal in ordinary state function reductions.

The following sections describe in detail the outcome of this progress.

1. In the first section gravimagnetic effect and its biological implications are discussed from TGD point of view.

2. In the second section the model for water memory and homeopathy is discussed and shown to lead to a general model for how immune system and bio-catalysis could have developed from their primordial versions,how dark proteins might have emerged as concrete representations for invader molecules making it possible to make the invader non-dangerous by attaching to its magnetic body, how DNA and genetic code could have emerged as symbolic representations for the magnetic bodies of invader molecules and later as symbolic representation of the magnetic body of the system itself. ZEO implies that actually time evolution of the magnetic body can be coded by DNA and protein folding could provide a concrete representation for this time evolution.

1.1 Some applications of the TGD based vision

The rest of the chapter is devoted to applications of the TGD based vision.

1.1.1 A model of protocell based on Pollack effect

The work carried out by David Zwicker and collaborators at the Max Planck Institute for the Physics of Complex Systems and the Max Planck Institute of Molecular Cell Biology and Genetics, both in Dresden leads to a concrete candidate for protocells as a water droplet containing proteins and able to exchange molecules with environment. In a simplified model for the droplets (P-granules in C-elegans cell is the real life example) the proteins in droplet can be in two states: in state A the stay in droplet and do not get out but can enter to the droplet from outside. In state B they can get out from droplet. To get into state B energy such as sunlight would be required.

TGD suggests a concrete counterpart for the droplet as exclusion zones (EZs) induced by energy feed such as radiation in water in Pollack effect. EZs are able remove inpurities from interior in conflict with second law. TGD based explanation of the mystery is change of the arrow of time induced by TGD counterpart of ordinary state function reduction in zero energy ontology (ZEO): self-organization would be dissipation with reversed arrow of time at at the magnetic body (MB) of system acting as master and forcing time reversed evolution at the level of ordinary bio-matter serving as a slave.

1.1.2 Was ribosome the first self-replicator?

This section was inspired by the article of M. Root-Bernstein and R. Root-Bernstein (daughter and father) [I32].

1. RNA world is basic example of "genetics first" models. The problem of the "genetics first models" is that it is difficult to understand how prebiotic life could have coped before the complex molecular machinery of metabolism. The second problem of RNA world is that polynucleotides and proteins almost certainly co-evolved. So called compositional replication

models start from this assumption but have difficulties in explain replication schemes. Both approaches fail to explain how complex cells emerged from molecular evolution. It is however known that lipid layers of cell membrane are emergent structures not coded by genes (soap films).

2. Second class of models try to proceed from complexity to simplicity by assuming the first replicator (pro-cell typically) but are not able to answer the question "What before this?". The natural assumption is that simple bio-molecules gradually evolved to polymers and polymer aggregates and eventually cell membrane emerged.

According to authors, the challenge is to bridge the gap between self-replicating polymers and a fully functional cell by identifying intermediate structures able to replicate, restore and replicate information, capture metabolic components and energy, and transform all these into biochemical networks.

The basic idea of the authors is simple and brilliant. Ribosome is the transcription machinery transforming DNA to proteins. Also the first replicator must have contained the transcription machinery. Perhaps the first replicator was minimal and contained just this machinery! Perhaps ribosome or its predecessor ("pre-ribosome") indeed was the first self-replicator. One would have beautiful self-reference: ribosome would be the recipe for making a copy about the recipe! Brings in mind Gödel-Escher-Bach!

In the TGD framework the natural solution to all hen-egg problems is provided by the predicted dark variants of the basic biomolecules. The dark variants of replication, transcription, translation, and metabolism would have been part of the fundamental physics and their chemical realizations would have emerged as a kind of shadow dynamics, mimicry.

1.1.3 Potential "missing link" in chemistry that led to life on Earth discovered

The phosphorylation of short nucleotide sequences and amino-acid sequences, and also lipids making possible formation of small cell membrane like structures is necessary for the formation of larger structures from their building bricks. As noticed, ribozymes catalyse only de-phosphorylation. How RNA was phosphorylated during RNA era or were the amino-acids present all the time?

The popular article with the title "*Potential 'missing link' in chemistry that led to life on Earth discovered*" (see `http://tinyurl.com/y9s56xnx`) tells about a mechanism allowing phosphorylation during RNA era in absence of enzymes. The discovery [I18] (see `http://tinyurl.com/y9kvgl24`) is that an organic molecule known as diamidophosphate (DAP) (see `http://tinyurl.com/y88vecs2`) having chemical formula $PO_2(NH_2)_2^{-1}$ could do the job in presence of water and imidazol. Imidazol (see `http://tinyurl.com/y8vgfr42`) has chemical formula$C_3N_2H_4$ and is a molecule possessing aromatic hetero-cycle consisting of 3 C atoms and 2 N atoms.

DAP could solve several problems simultaneously: how the short sequences of RNA (later DNA) and amino-acids were formed, and how the predecessors of cell membranes emerged. It is not however clear to me whether this process could have been fast enough or whether the slowness only made the first step painful.

The challenge is to circumvent the problem and the proposal considered suggests that a molecule known as di-amido-phosphate (DAP) could have solved the problem. TGD based view is that both the cell membraneand all basic biomolecules could have emerged more or less simultaneously by pairing with their dark variants. Also the basic catalytic mechanisms would have been present at the level of dark matter as $h_{eff} = nh_0$ phases.

1.1.4 Life in Venus? What says TGD?

Evidence for life in a rather unexpected place - Venus - has emerged. The atmosphere of Venus shows signs of phosphine PH_3 - the analog of ammonium NH_3 -, which cannot be produced by inorganic processes. There are small amounts of phosphine in the Earth's atmosphere and has an organic origin. Same might be true in the case of Venus. Perhaps simple bacterial life is in question. Is it in the atmosphere or somewhere deeper in an open question.

TGD based vision about quantum biology suggests several options. The most conservative option suggested by TGD relies on the analogy between H_2S and water. The magnetic body (MB) of H_2S realizing also dark variants of basic bio-molecules could play the same role as the

MB of water. First proto cell membrane would have formed and led to the development of O-S separation so that the interior of the proto cell would have consisted mostly of water allowing ordinary bio-molecules to evolve.

One can consider also the replacement $O \to S$ occurs in the basic bio-molecules- DNA, RNA,tRNA, and amino acids. This would leave cell membrane as such. A less plausible replacement (O,N,P) $\to$ (S,P,As) shifting life downwards along the Periodic Table is also discussed.

1.1.5 Multilocal viruses

Multi-local viruses are mysterious from the point of view of ordinary biology. The DNA, RNA, and proteins of these viruses divides into segments located at different host cells and can self-assemble back to the ordinary virus. Various partitions of the virus are possible. TGD based view about space-time and quantum theory allows to understand these viruses as connected entities at the level of magnetic body (MB). MB containing dark matter in TGD sense would control the dynamics of what looks like multi-local entity at the level of ordinary matter. Also bacteria could be seen as multi-local entities of this kind and the recent findings about states of bacterial colonies analogous to multi-cellulars resembling embryos of multi-cellulars suggests how multi-cellulars evolved from mono-cellulars. An interesting application is to the TGD view about Cambrian Explosion in which highly evolved multi-cellulars evolved. Ontogeny recapitulates phylogeny principle provides support for the view that multicellular life evolved in underground oceans defining the womb of Mother Gaia and bursted to the surface as the radius of Earth doubled in a phase transition reducing the value of local cosmological constant.

1.1.6 Oil droplets in water solution as a primitive life form?

The origin of life is one the most fascinating problems of biology. The classic experiment was carried out almost 60 years ago. In the experiment sparks were shot through primordial atmosphere consisting of methane, ammonia, hydrogen and water and the outcome was many of the amino-acids essential for life. The findings raised the optimism that the key to the understanding of the origins of life. After Miller's death 2007 scientists re-examined sealed test tubes from the experiment using modern methods found that well over 20 amino-acids - more than the 20 occurring in life - were produced in the experiments.

The Urey-Miller experiments have yielded also another surprise: the black tar consisting mostly of hydrogen cyanide polymer produced in the experiments has turned out to be much more interesting than originally thought and suggests a direction where the candidates for precursors of living cells might be found. In the earlier experiments nitrobenzene droplets doped with oleic anhydride exhibited some signatures of life. The droplets were capable to metabolism using oleic anhydride as "fuel" making it possible for the droplet to move. Droplets sensed each other's presence and reacted to it and also demonstrated rudimentary memory.

In the sequel a model for the oil droplets as primitive life form is developed using as a constraint the TGD inspired quantum model for living matter. The key ingredients are the notions of magnetic body, the assignment of dark matter identified a hierarchy of macroscopic quantum phases to a hierarchy of Planck constants, zero energy ontology, the model for DNA-cell membrane system as topological quantum computer, and Negentropy Maximization Principle combined with the notion of number theoretic entropy. This entropy can be negative for rational and even algebraic entanglement probabilities, which inspires the vision about life as something in the intersection of real and p-adic worlds.

The basic objection against the identification of oil droplets as a primitive life form is that droplets have no genetic code and do not replicate. The TGD inspired model for dark nucleons however predicts that the states of dark nucleon are in one-one correspondence with DNA, RNA, tRNA, and amino-acid molecules and that vertebrate genetic code is naturally realized. The question is whether the realization of the genetic code in terms of dark nucleon strings might provide the system with genetic code and whether the replication could take place at the level of dark nucleon strings rather than droplets. TGD inspired quantum model of biology leads to a model for oil droplets as a primitive life form. In particular, a proposal for how dark genes could couple to chemistry of oil droplets is developed.

The appendix of the book gives a summary about basic concepts of TGD with illustrations. Pdf representation of same files serving as a kind of glossary can be found at `http://tgdtheory.fi/tgdglossary.pdf` [L1].

2 Implications Of Strong Gravimagnetism For TGD Inspired Quantum Biology

Physicists M. Tajmar and C. J. Matos and their collaborators working in ESA (European Satellite Agency) have made an amazing claim of having detected strong gravimagnetism with gravimagnetic field having a magnitude which is about 20 orders of magnitude higher than predicted by General Relativity [E2]. If the findings are replicable they mean a revolution in the science of gravity and, as one might hope, force a long-waited serious reconsideration of the basic assumptions of the dominating super-string approach.

Tajmar et al have proposed [E4] the gravimagnetic effect as an explanation of an anomaly related to the superconductors. The measured value of the mass of the Cooper pair is slightly larger than the sum of masses whereas theory predicts that it should be smaller. The explanation would be that actual London field is larger than it should be because of gravimagnetic contribution to quantization rule used to deduce the value of London field.

TGD explanation of the discrepancy accepting the theory of Tajmar et al comes from the proposal inspired by Nottale's observations [E1] suggesting that Bohr's rules apply in planetary system with Planck constant replaced by $\hbar_{gr} = GMm/v_0$. Here M and m are the masses of Sun and planet. $v_0/c \simeq 2^{-11}$ holds true for the 3 inner planets and $v_0 \to v_0/5$ for the outer planets. The rotation velocities of the planets are related to v_0 by Bohr rules. h_{gr} clearly characterizes the pair Sun-planet rather than being fundamental constant whereas the gravitational Compton length GM/v_0 depends on M only. In TGD framework one assigns gravitational Planck constant to the flux tube connecting the masses and along which the gravitational massless extremals mediating the gravitational interaction are mediated. By Equivalence Principle it is possible to apply the hypothesis only in elementary particle length scales (this does not exclude its application in longer scales) and in these scales $h_{eff} = h_{gr}$ makes sense.

Gravimagnetic London field is proportional to the square of Planck constant and the obvious guess is that the replacement h with h_{gr} could explain the enormous discrepancy with GRT if gravimagnetism is in question. This predicts correctly the magnitude of the effect and one also ends up with the identification of the $h_{gr} = h_{eff}$ in elementary particle scales.

Also a vision about the fundamental role of quantum gravitation in living matter emerges. The earlier hypothesis that dark EEG photons decay to biophotons with energies in visible and ultraviolet range [K19, K18] receives strong quantitative support. This leads also to a simple model for how magnetic bodies control molecular transitions via dark cyclotron radiation with varying frequencies vary but universal energy spectrum since for a given magnetic field all charged particles gives rise to biophotons with same energy. The values of h_{gr}/m and endogenous magnetic field $B_{end} \simeq .2$ Gauss are such that the spectrum of biophotons is in the range of molecular binding energies. This vision would conform with Penrose intuitions about the fundamental role of gravitation in quantum biology.

2.1 The Theory fof Tajmar et al for fhe Anomaly ff Cooper Pairs Mass

The starting point of the theory of Tajmar and Matos [E4] is the so called London magnetic moment generated in rotating charged super-conductors adding a constant contribution to the exponentially damped Meissner contribution to the magnetic field. This contribution can be understood as being due to the massivation of photons in super-conductors. The modified Maxwell equations are obtained by just adding scalar potential mass term to Gauss law and vector potential mass term to the equation related the curl of the magnetic field to the em current.

The expression for the London magnetic field is given by

$$B = 2\omega_R n_s \times \lambda_\gamma^2 \ , \tag{2.1}$$

where ω_R is the angular velocity of superconductor, n_s is charge density of super-conducting particles and $\lambda_\gamma = \hbar/m_\gamma$ is the wave length of a massive photon at rest. In the case of ordinary superconductor one has $\lambda_\gamma = \sqrt{m^*/q^* n_s}$, where $m^* \simeq 2m_e$ and $q^* = -2e$ are the mass and charge of Cooper pair. Hence one has

$$B = -2\frac{m^*}{2e}\omega_R \ . \tag{2.2}$$

Magnetic field extends also outside the super-conductor and by measuring it with a sufficient accuracy outside the super-conductor one can determine the value of the electron mass. Instead of the theoretical value $m^*/2m_e = .999992$ which is smaller than one due to the binding energy of the Cooper pair the value $m^*/2m_e = 1.000084$ was found by Tate [E3]. This inspired the theoretical work generalizing the notion of London field to gravimagnetism and the attempt to explain the anomaly in terms of the effects caused by the gravimagnetic field.

Note that in the case of ordinary matter the equations would lead to an inconsistency at the limit $m_\gamma = 0$ since the value of London magnetic field would become infinite. The resolution of the problem proposed in [E4] is based on the replacement of rotation frequency ω with electron's spin precession frequency $\omega_L = -eB/2m$ so that the consistency equation becomes $B = -B = 0$ for a unique choice $1/\lambda_\gamma^2 = -\frac{q}{m}n$. One could also consider the replacement of ω with electron's cyclotron frequency $\omega_c = 2\omega_L$. To my opinion there is no need to assume that the modified Maxwell's equations hold true in the case of ordinary matter.

2.1.1 Gravimagnetic field

The perturbative approach to the Einstein equations leads to equations, which are essentially identical with Maxwell's equations. The g_{tt} component of the metric plays the role of scalar potential and the components g_{ti} define gravitational vector potential. Also the generalization to the super-conducting situation in which graviphotons develop a mass is straightforward. Just add the scalar potential mass term to the counterpart of Gauss law and vector potential mass term to the equation relating the curl of the gravimagnetic field to the gravitational mass current.

In the case of a rotating superconductor London magnetic field is replaced with its gravimagnetic counterpart

$$B_{gr} = -2\omega_R \rho_m \lambda_{gr}^2 \ . \tag{2.3}$$

Obviously this formula would give rise to huge gravimagnetic fields in ordinary matter approaching infinite values at the limit of vanishing gravitational mass. Needless to say, these kind of fields have not been observed.

Equivalence Principle however suggests that the gravimagnetic field must be assigned with the rotating coordinate frame of the super-conductor. Equivalence principle would state that seing the things in a rotating reference frame is equivalent of being in a gravimagnetic field $B_{gr} = -2\omega_R$ in the rest frame. This fixes the graviphoton mass to

$$\frac{1}{\lambda_{gr}^2} = (\frac{m_{gr}}{\hbar})^2 = G\rho_m \ . \tag{2.4}$$

For a typical condensed matter density parameterized as $\rho_m = Nm_p/a^3$, $a = 10^{-10}$ m this gives the order of magnitude estimate $m_{gr} \sim N^{1/2}10^{-21}/a$ so that graviton mass would be extremely small.

If this is all what is involved, gravimagnetic field should have no special effects. In [E4] it is however proposed that in superconductors a small breaking of Equivalence Principle occurs. The basic assumptions are following.

1. Super-conducting phase and the entire system obey separately the gravitational analogs of Maxwell field equations.

2. The ad hoc assumption is that for super-conducting phase the sign of the gravimagnetic field is opposite to that for the ordinary matter. If purely kinematic effect were in question so that graviphotons were pure gauge degrees of freedom, the value of m_{gr}^2 should should be proportional to ρ_m and $\rho_m - \rho_m^*$ respectively.

3. Graviphoton mass is same for both ordinary and super-conducting matter and corresponds to the net density ρ_m of matter. This is essential for obtaining the breaking of Equivalence Principle.

With these assumptions the gravimagnetic field giving rise to acceleration field detected in the rest system would be given by

$$B_{gr}^* = \frac{\rho_m^*}{\rho} \times 2\omega \tag{2.5}$$

This is claimed to give rise to a genuine acceleration field

$$g^* = -\frac{\rho_m^*}{\rho} a \tag{2.6}$$

where a is the radial acceleration due to the rotational motion.

2.1.2 Explanation for the too high value of measured electron mass in terms of gravimagnetic field

A possible explanation of the anomalous value of the measured electron mass [E3] is in terms of gravimagnetic field affecting the flux Bohr quantization condition for electrons by adding to the electromagnetic vector potential term $q^* A_{em}$ gravitational vector potential $m^* A_{gr}$. By requiring that the quantization condition

$$\oint (m^* v + q^* A_{em} + m^* A_{gr}) dl = 0 \tag{2.7}$$

is satisfied for the superconducting ring, one obtains

$$B = -\frac{2m}{e}\omega - \frac{m}{e} B_{gr} \ . \tag{2.8}$$

This means that the magnetic field is slightly stronger than predicted and it has been known that this is indeed the case experimentally.

The higher value of the magnetic field could explain the slightly too high value of electron mass as determined from the magnetic field. This gives

$$B_{gr} = \frac{\Delta m_e}{m_e} \times 2\omega = \frac{\Delta m_e}{m_e} \times e m_e \times B \ . \tag{2.9}$$

The measurement implies $\Delta m_e/m_e = 9.2 \times 10^{-5}$. The model discussed in [E4] predicts $\Delta m_e/m_e \sim \rho^*/\rho$. The prediction is about 23 times smaller than the experimental result.

2.2 Is The Large Gravimagnetic Field Possible In TGD Framework?

TGD allows top consider several alternative solutions for the claimed effect.

Many-sheeted space-time could be an essential part of the effect (if real!).

1. In TGD framework both induced metric and various gauge fields are expressible in terms of CP_2 coordinates and their gradients. Hence the gravimagnetic field would be very probably accompanied by an ordinary magnetic field and could be even proportional to it.

2. The ordinary London magnetic field could be accompanied by analogous magnetic field at different space-time sheet playing the same role as gravimagnetic field in the proposed model. Cooper pair would experience both fields by forming topological sum contacts to both space-time sheets carrying ordinary London magnetic field $B = m_e/e\omega_R$ and much smaller London magnetic field $\Delta B = \Delta m/e\omega_R$? There would be no need to introduce gravitation but one should explain why the value of the parameter $\epsilon = \Delta m_e/m_e$ is what it is.

3. In many-sheeted space the gravimagnetic field and accompanying magnetic field would be associated with the flux tubes mediating gravitational interaction with dark matter fraction of Earth's mass. It would not be surprising if the size of the parameter ϵ might be determined by this fraction. Pioneer and Flyby effects [K27] allow to make a rough estimate for the size of this fraction and the outcome is about 2×10^{-4} which is not far from $\epsilon.9 \times 10^{-4}$.

An alternative explanation is that the experiments probe single space-time sheet and that also other Z^0 magnetic field contributes below weak scale which is scaled up for $h_{eff} = n \times h$ and can be macroscopic.

1. TGD predicts the possibility of classical electro-weak fields at larger space-time sheets. If these couple to Cooper pairs generate exotic weak charge at super-conducting space-time sheets the Bohr quantization conditions modify the value of the magnetic field. Exotic weak charge would however mean also exotic electronic em charge so that this option is excluded. It would also require that the Z^0 charge of test bodies used to measure the acceleration field is proportional to their gravitational mass.

2. According to the simplest recent view about Kähler-Dirac action [K13] the modes of Dirac operator are confined to 2-D string world sheets at which classical W boson fields vanish. This guarantees that em charge is well-defined for the modes. The stronger condition that also classical Z^0 field vanishes makes also sense and should hold at least in the length scales in which weak bosons do not appear. This guarantees the absence of axial couplings and parity breaking effects. In living matter parity breaking effects are large and one could consider the possibility that weak length scale is scaled up for $h_{eff} > h$ and that classical Z^0 fields are present below the weak scale.

3. One cannot exclude the possibility that the classical weak fields vanish for entire space-time surface. In this case spinor modes can still be seen as continuous superpositions of 2-D ones. In principle one can consider also other options - such as vanishing of induced Kḧler form or classical em field besides that of W fields.

The conservative option is that classical weak fields vanish in the situation considered so that there is room for the strong gravimagnetic field. The following model starts from the model of Tajmar et al and generalizes it by replacing Planck constant with its gravitational counterpart.

2.2.1 Modification of the model of Tajmar et al by replacing h with h_{gr}

Gravimagnetic London field is proportional to the square of Planck constant and the obvious guess is that the replacement h with h_{gr} could explain the enormous discrepancy with GRT if gravimagnetism is in question. This predicts correctly the magnitude of the effect and one also ends up with the identification of the $h_{gr} = h_{eff}$ in elementary particle scales.

One can of course develop an objection against the gravimagnetic field proportional h_{eff}^2: also ordinary London magnetic field should be scaled in the same manner due to the proportionality to λ_γ^2. The resulting magnetic field would be enormous. One can however argue that the increase of Planck constant cannot affect the value of the ordinary London magnetic field. The scaling up of length scales by h_{eff} and flux conservation suggest that the value of B scales down like $1/h_{eff}^2$. This factor is compensated by the h_{eff}^2 factor in the expression of London magnetic field coming from the expression of magnetic penetration length in terms of mass of photon. One can of course ask why magnetic and gravimagnetic London field are different.

1. The formula used by Tajmar et al [E4] for the gravimagnetic variant of London magnetic field is direct generalization for the London field for ordinary super-conductor. The gravimagnetic field is proportional to the product $B_g = \omega_R r^2$ of the rotation frequency ω_R of

super-conductor and square of the ratio $r = (\lambda_g/\lambda_{g,T})$, where $\lambda_g = \hbar/m_g$ is graviton wave length and $\lambda_{g,T}$ is gravimagnetic penetration length obtained as generalization of the magnetic penetration length for super-conductors by replacing charge with mass. The latter is purely classical quantity whereas graviton wave length depends on Planck constant. Graviton mass can be argued to result in gravitational Meissner effect and can be estimated from the value of cosmological constant Λ being essentially its square root. The resulting value of B_g is too small by 28 orders of magnitude.

2. Tajmar et al [E4] suggests that graviton mass is larger by a factor of order 10^{14} in conflict with the experimental upper bound of order 10^{55} kg for m_g. TGD proposal is that it is Planck constant which should be replaced with effective Planck constant $h_{eff} = nh$ equal to gravitational Planck constant h_{gr} for electron Cooper pair in Earth's gravitational field. The model for planetary orbits as Bohr orbits together with Equivalence Principle implies $\hbar_{gr} = GMm/v_0$ at flux tubes connecting particle with mass m to Sun with mass M. v_0 has dimensions of velocity and has order of magnitude correlating with a typical rotation velocity of planetary orbit by Bohr quantization rules.

3. In the recent case the rotation velocity v_0 is the rotation velocity of Earth at its surface: $v_0(E)/c = 2.16 \times 10^{-6}$ to be compared with $v_0(S)/c \simeq .5 \times 10^{-3}$ for Sun-Earth system. The scaling of λ_g is given by $h_{gr}(E, pair)/h = (h_{gr,S,pair}/h) \times (M_E/M_S) \times v_0(S)/v_0(E)$. This gives

$$r \equiv \frac{h_{gr,S,pair}}{h} = \frac{\lambda(h_{gr,S,pair}}{\lambda(h, pair)} = \frac{\frac{GM}{v_0(S)}}{\lambda_c(pair)} = \frac{\frac{r_S}{v_0(S)}}{\lambda_c(e)} \quad .$$

Using $r_S = 3km$ and $\lambda_e = .243 \times 10^{-12}$ m and $v_0(S) \simeq 2^{-11}$, $M_E/M_S = 3.0 \times 10^{-6}$ one obtains $r \simeq 3.6 \times 10^{14}$. This happens to be correct order of magnitude! Maybe the model might have something to do with reality. Even better, also the value of h_{eff} is consistent with its value spectrum appearing in EEG if one requires that the energy of dark EEG photon with frequency of order 10 Hz is that of biophoton with frequency of about 5×10^14 Hz. If this picture is correct the values of $h_{eff} = h_{gr}$ would comes as proportional to the masses of particles and cyclotron energies proportional to heB/m would not depend on the mass of the particle at all.

4. What is nice that the model unifies the notions of gravitational Planck constant and dark Planck constant. The basic observation is that Equivalence Principle allows to understand the effects of h_{gr} by reducing it to elementary particle level interpreted in terms of flux tubes connecting particle to the bigger system. This allows to avoid gigantic values of h_{gr} and gives connection with TGD inspired quantum biology. The new quantum physics associated with gravitation would also become key part of quantum biology.

2.2.2 Could $h_{gr} = h_{eff}$ hold true?

The obvious question is whether the gravitational Planck constant deduced from the Nottale's considerations and the effective Planck constant $h_{eff} = nh$ deduced from ELF effects on vertebrate brain and explained in terms of non-determinism of Kähler action could be identical. At first this seems to be non-sensical idea since $\hbar_{gr} = GMm/v_0$ has gigantic value.

It is however essential to realize that by Equivalence Principle one describe gravitational interaction by reducing it to elementary particle level. For instance, gravitational Compton lengths do not depend at all on the masses of particles. Also the radii of the planetary orbits are independent of the mass of particle mass in accordance with Equivalence Principle. For elementary particles the values of h_{gr} are in the same range as in quantum biological applications. Typically 10 Hz ELF radiation should correspond to energy $E = h_{eff}f$ of UV photon if one assumes that dark ELF photons have energies of biophotons and transform to them. The order of magnitude for n would be therefore $n \simeq 10^{14}$.

The experiments of M. Tajmar et al [E2, E4] discussed in [K28] provide a support for this picture. The value of gravimagnetic field needed to explain the findings is 28 orders of magnitude higher than theoretical value if one extrapolates the model of Meissner effect to gravimagnetic

context. The amazing finding is that if one replaces Planck constant in the formula of gravimagnetic field with h_{gr} associated with Earth-Cooper pair system and assumes that the velocity parameter v_0 appearing in it corresponds to the Earth's rotation velocity around its axis, one obtains correct order of magnitude for the effect requiring $r \simeq 3.6 \times 10^{14}$.

The most important implications are in quantum biology and Penrose's vision about importance of quantum gravitation in biology might be correct.

1. This result allows by Equivalence Principle the identification $h_{gr} = h_{eff}$ at elementary particle level at least so that the two views about hierarchy of Planck constants would be equivalent. If the identification holds true for larger units it requires that space-time sheet identifiable as quantum correlates for physical systems are macroscopically quantum coherent and gravitation causes this. If the values of Planck constant are really additive, the number of parallel space-time sheets corresponding to non-determinism evolution for the flux tube connecting systems with masses M and m is proportional to the masses M and m using Planck mass as unit. Information theoretic interpretation is suggestive since hierarchy of Planck constants is assumed to relate to negentropic entanglement very closely in turn providing physical correlate for the notions of rule and concept.

2. That gravity would be fundamental for macroscopic quantum coherence would not be surprising since by EP all particles experience same acceleration in constant gravitational field, which therefore has tendency to create coherence unlike other basic interactions. This in principle allows to consider hierarchy in which the integers $h_{gr,i}$ are additive but give rise to the same universal dark Compton length.

3. The model for quantum biology relying on the notions of magnetic body and dark matter as hierarchy of phases with $h_{eff} = n \times h$, and biophotons [K19, K18] identified as decay produces of dark photons. The assumption $h_{gr} \propto m$ becomes highly predictable since cyclotron frequencies would be independent of the mass of the ion.

   (a) If dark photons with cyclotron frequencies decay to biophotons, one can conclude that biophoton spectrum reflects the spectrum of endogenous magnetic field strengths. In the model of EEG [K4] it has been indeed assumed that this kind spectrum is there: the inspiration came from music metaphors suggesting that musical scales are realized in terms of values of magnetic field strength. The new quantum physics associated with gravitation would also become key part of quantum biophysics in TGD Universe.

   (b) For the proposed value of h_{gr} 1 Hz cyclotron frequency associated to DNA sequences would correspond to ordinary photon frequency $f = 3.6 \times 10^{14}$ Hz and energy 1.2 eV just at the lower limit of visible frequencies. For 10 Hz alpha band the energy would be 12 eV in UV. This plus the fact that molecular energies are in eV range suggests very simple realization of biochemical control by magnetic body. Each ion has its own cyclotron frequency but same energy for the corresponding biophoton.

   (c) Biophoton with a given energy would activate transitions in specific bio-molecules or atoms: ionization energies for atoms except hydrogen have lower bound about 5 eV (`http://tinyurl.com/233vcad`). The energies of molecular bonds are in the range 2-10 eV (`http://tinyurl.com/bfsy4ft`). If one replaces v_0 with $2v_0$ in the estimate, DNA corresponds to.62 eV photon with energy of order metabolic energy currency and alpha band corresponds to 6 eV energy in the molecular region and also in the region of ionization energies.

   Each ion at its specific magnetic flux tubes with characteristic palette of magnetic field strengths would resonantly excite some set of biomolecules.This conforms with the earlier vision about dark photon frequencies as passwords.

   It could be also that biologically important ions take care of their ionization self. This would be achieved if the magnetic field strength associated with their flux tubes is such that dark cyclotron energy equals to ionization energy. EEG bands labelled by magnetic field strengths could reflect ionization energies for these ions.

   (d) The hypothesis means that the scale of energy spectrum of biophotons depends on the ratio M/v_0 of the planet and on the strength of the endogenous magnetic field, which

is.2 Gauss for Earth (2/5 of the nominal value of the Earth's magnetic field). Therefore the astrophysical characteristics of planets should be tuned for molecular life. Taking v_0 to be rotational velocity one obtains for the ratio $M(planet)/v_0(planet)$ using the ratio for Earth as unit the following numbers for the planets (Mercury, Venus, Earth, Mars, Jupiter, Saturnus, Uranus, Neptune): $M/v_0 = (8.5, 209, 1, .214223, 1613, 6149, 9359)$. If the energy scale of biophotons is required to be the same, the scale of endogenous magnetic field should be divided by this ratio in order to obtain the same situation as in Earth. For instance, in Mars the magnetic field should be roughly 5 times stronger: in reality the magnetic field of Mars is much weaker. Just for fun one can notice that for Sun the ratio is 1.4×10^6 so that magnetic field should be by the inverse of this factor weaker.

4. An interesting question is how large systems can behave as coherent units with $\hbar_{gr} = GMm/v_0$. In living matter one might consider the possibility that entire organism might be this kind of system. Interestingly, for larger masses the gravitational quantum coherence would be easier. For particle with mass m $h_{gr}/h > 1$ requires larger mass to satisfy $M > M_P^2/m_e$. The first guess that life has evolved from long to shorter scales and reached elementary particle last. Planck mass is the critical mass corresponds to the mass of water blog with volume of size scale of 10^{-4} m (big neuron) is the limit.

5. The Universal gravitational Compton wave length of $GM/v_0 \simeq 864$ meters gives an idea about largest possible living matter system if Earth is the second body. Of course, also other large bodies are possible.In the case of solar system this length is 3×10^3 km. The radius of Earth is 6.37×10^3 km - roughly twice the Compton length. The radii of Mercury, Venus, Earth, Mars, Jupiter, Saturnus, Uranus, Neptunus are (.38, .99, .533, 1, 10.6, 8.6, 4.0, 3.9) using Earth radius as unit the value of h_{gr} is by factor 5 larger than for three inner planets so that the values are reasonably near to gravitational Compton length or twice it. Does this mean that dark matter associated with Earth and maybe also other planets is in macroscopic quantum state at some level of the hierarchy of space-time sheets? Does this mean that Mother Gaia as conscious entity might make sense. One can of course make same question in the case of Sun. The universal gravitational Compton length in Sun would be 18 per cent of the radius of Sun if v_0 is taken to be the rotational velocity at the surface of Sun. The radius of solar core, where fusion takes place, is 20-25 per cent of solar radius.

6. There are further interesting numerical co-incidences. One can for a moment forget the standard hostility of scientist towards horoscopes and ask whether Sun and Moon could have somehow affect our life via astrocopic quantum coherence. The gravitational Compton length for particle-Moon or particle-Sun system multiplied by the natural value of magnetic field is the relevant parameter. For Sun the parameters in question are mass of Sun, and rotational velocity of Earth with respect to Sun, plus magnetic fields of Sun at flux tubes associated with solar magnetic field measured to be about 5 nT at the position of Earth and 100 times stronger than expected from dipole field behavior. This gives that the range of biophoton energies is scaled down with factor of 1/4 in good approximation so that Father Sun might affect terrestrial biology! If one uses for the rotational velocity of particle at surface of Moon as parameter v_0 (particle would be at Moon), biophoton energy scaled scaled up by factor 1.2.

The general proposal discussed above is testable. In particular, a detailed study of molecular energies with those associated with resonances of EEG could be highly rewarding and reveal the speculated spectroscopy of consciousness.

2.2.3 What about $h_{em} = h_{eff}$?

The notion of h_{gr} generalizes to that for other interactions. For instance, in electromagnetic case the formation of strong em fields implying charge separation leads to systems in which $h_{em} = Z_1 Z_2 e^2/v_0$ is large. Pollack's exclusion zone [L4] (`http://tinyurl.com/oyhstc2`) and its complement define this kind of system and TGD inspired identification is as prebiotic life form. I have proposed a TGD inspired model for the fourth phase of water [K14] [L4].

I have proposed that metabolic machinery generates large h_{eff} phase somehow. $h_{eff} = h_{em}$ hypothesis allows to develop this hypothesis in more detail.

1. The rotating shaft of a molecular motor associated with ATP synthase is proposed to play a key role.

2. What comes in mind is that the rotational velocity v_0 of the shaft appears in the formula for h_{em}. The electric field over the mitochondrial membrane generates charge separation and the product of charges of shaft and its complement should appear in the expression for h_{em}.

3. The value of v_0/c is expected to be of order 10^{-14} from the angular rotation rate of ADP synthase about few hundred revolutions per second. The lower bound for the magnitude for h_{em} is same as for h_{gr} associated with Earth-particle system.

Rotating magnetic systems are claimed to exhibit anomalous effects such as spontaneous acceleration and over unity energy production. I have discussed these in [K1].

1. The proposal is that rotating magnetic systems give rise to dark matter at magnetic flux tubes and sheets associated with the system and that the metabolic energy is needed to rotate the motor to generate the dark matter, which in turn makes possible negentropic entanglement characterized the density matrix proportional to unit matrix. This kind of matrix results if entanglement coefficients form a unitary S-matrix characterizing also quantum computation as unitary process.

2. The parameter v_0 appearing in the general formula for h_{eff} assigned with either em - or gravitational flux tubes is identifiable as the rotation velocity. One has $v_0/c \simeq 3 \times 10^{-8}$.

3. Since these systems are strongly charged, a natural guess is that large h_{em} system is in question.

2.3 Gravitational Mother Gaia And Life

Negentropic entanglement (NE) is one of the key notions of TGD inspired quantum biology. For instance, it would seem that NE would look more natural metabolic resource than energy. Nutrients should carry it. NE is however not single particle property but between nutrient and some other system in the recent case. What can one say about this system? Can it be part of nutrient? Could it correspond to oxygen molecules? Or could it be Mother Gaia identified in some sensible manner?

If one believes on the presence of gravimagnetic flux tubes and their role as generator of macroscopic quantum coherence in biology then one is forced to consider seriously also NE between its ends. If this is the case then the view of religions about life might be nearer to truth than that of hard-born materialists.

To make this more concrete, let us first look what the transfer of NE could mean.

1. Suppose that nutrient N has NE with unknown system A which a priori could be part of nutrient. Assume that the transfer of NE of nutrient with A is formed by reconnection of U-shaped flux tubes associated with N (or glucose G produced from it) and A so that two parallel flux tubes connecting N and A are formed.

2. The basic operation allowing transformation of $N - A$ NE to $P - A$ NE is following. The two flux tube portions of U-shaped flux associated with the receiver R are reconnected with the two parallel flux tubes connecting N and A so that two flux tubes connecting R to A are formed. NMP strongly suggests that the entanglement remains negentropic in the process.

3. NE is first transferred to P using this process so that P and A are now NE-connected. After this P attaches to ADP to yield ATP and ATP attaches to B and the transfer process leads to NE between B and A.

   For ATP synthase the h_{em} consisting two elementary charges is of the same order as h_{gr}. This is probably not an accident. Could this mean that this kind of flux tube can reconnect with gravitational flux tube? Could this make possible a reconnection transforming N-Earth NE to P-Earth NE? This looks plausible.

Consider now the identification of A.

1. If one assumes that the negentropic entanglement (see **Fig.** `http://tgdtheory.fi/appfigures/cat.jpg` or **Fig. ??** in the appendix of this book) corresponds to gravitational flux tubes for N-Earth system then A should be gravitational Mother Gaia, whatever its precise definition might be. N (and glucose) molecules would be alive in the sense that they have NE with Mother Gaia.

2. Could oxygen have some deeper role? For instance, could O_2 molecules serve as analogs of cell membrane receptors for Mother Gaia meaning that gravitational flux tubes go through O_2 molecules? This does not look plausible since metabolism is possible also as fermentation involving no oxygen.

3. In this picture the role of breathing and fermentation would be to make possible the transfer of NE from nutrients to the living system.

This picture allows to imagine about what might happen in biological death. Biological death takes first place only at the highest level of self hierarchy assignable to the our biological body. Cells continue for some time their life even after the last breath. The notion of h_{gr} together with Equivalence Principle suggests that the living biological body has negentropic flux tube connections to both electromagnetic magnetic body (personal magnetic body) and to gravitational Mother Gaia (MG) representing collective consciousness in the scale of Earth. Also personal magnetic body has flux tube connections to MG. The latter especially during sleep. Also connections to higher levels in hierarchy are possible. At the moment of biological death the negentropic flux tube pairs connecting the personal magnetic body to biological body are split and only those with MG remain or are generated in this process. This would happen later at lower levels of biological self hierarchy such as organ and organelles and eventually for cells and biopolymers. On the other hand, new life forms using the decay products as nutrients would take the available NE to use during the decay process.

The quantum model for metabolism allows to understand life as a process in which negentropic entanglement of gravitational Mother Gaia with nutrients is transformed to that of molecules of biological body with personal magnetic body and further processed and enriched. At the moment of biological death this information returns to the gravitational Mother Gaia. By NMP information is not lost but increases steadily giving rise to "Akashic records". This view conforms with the core ideas of spiritual and religious teachings.

3 TGD Inspired Model For The Formation Of Exclusion Zones From Coherence Regions

There is a talk of Mae-Wan Ho (`http://tinyurl.com/ybbyn4pc`) in Conference on the Physics, Chemistry and Biology of Water 2014. It is a very nice representation and I learned new facts highly relevant for my own work.

Some background articles might be helpful. Mae-Wan Ho [I30] has proposed that there exists superconducting liquid crystal water aligned with collage fibres. Giudice et al [I13] have proposed that water dynamics is at the root of metamorphosis in living matter: this involves the notion of water coherent region (CD) with size scale of 1 micrometer. I have not considered this notion in TGD framework earlier but TGD strongly suggests that the four Gaussian Mersennes $M_{G,k}$, $k = 151, 157, 164, 167$ with corresponding p-adic length scales coming as $L(k) = 2^{(k-151)/2} times L(151)$, $L(151)$=10 nm are important in biology: $k = 167$ corresponds to 2.5 micrometers. Pollack and et al [I33, I31] have introduced the concept of exclusion zone (EZ) with size scale of 200 nm and related notion fourth phase of water. TGD inspired model of EZ involves in essential manner dark protons at magnetic flux tubes assignable to EZ [K26, K16].

The main points of Mae-Wan Ho's talk are following.

1. Protons make water a conductor, maybe even superconductor. In TGD framework the statement would be that dark protons flowing along magnetic flux tubes make this possible. Personally I believe that electronic and even ionic Cooper pairs are are involved and TGD

based model of cell membrane [K12] assumes these super-conductivities relying on the notion of dark matter realizes as $h_{eff} = n \times h$ phases.

2. The water associated with collagen networks appears as superconductor and superfluid in nano-scales. Also this is very attractive idea and if the $h_{eff} = h_{gr}$ condition holds as some arguments suggest, then superfluidity allowing macroscopic quantum coherence with gravitational Compton length having no dependence on the mass of particle becomes possible [K26]. This is due to two facts. First, one has $\hbar_{gr} = GMm/v_0$, where M can be identified as dark part of the Earth's mass, m is the mass of the particle and v_0 is velocity parameter. Secondly, Compton length is inversely proportional to the mass. One of the strange effects involved with superfluidity is fountain effect explained elegantly by macroscopic quantum gravitational coherence: water would effectively defy gravitation: this effect might allow testing of the hypothesis.

3.1 CDs And Ezs

Mae Wan-Ho talked about and compared two notions: CDs (coherent domains of water with size of about micrometer postulated by quantum field theoreticians, in particular Emilio del Giudice) and EZs (exclusion domains with size about 200 micrometers discovered by Gerald Pollack and collaborators experimentally). Note that in Zero Energy Ontology (ZEO) I talk about causal diamonds (CDs), which are typically much larger than CDs of Giudice et al.

1. Inside EZ the water forms layered structure consisting of hexagonal layers and the stoichiometry is $H_{1.5}O$ so that every fourth proton must be outside EZ (proton is not accompanied by electron if charge separation takes place: EZ is indeed negatively charged so that one obtains different pHs inside EZ and in its exterior). This state is experimentally heavier than ordinary water.

2. So called tetrahedral or 4-coordinated water is assigned with CDs. CDs and EZs could correspond to two different p-adic length scales in TGD framework. This state would be less dense than ordinary water. Both CD and EZ contain plasma of almost free electrons. CDs are excited to 12.06 eV just.5 eV below the ionizing potential 12.56 eV..5 eV which is the nominal value of metabolic energy quantum - probably not an accident.

3.2 TGD Inspired Model For CDs And Ezs

I try my best to summarise some very interesting points of the talk and develop in more detail TGD inspired model for EZs and their formation, and the TGD view of metabolism leading to a prediction of new form of metabolism involving dark UV photons from Sun.

1. The splitting of ordinary water H_2O to $2H^+ + 2e^- + O$ is a key step in photosynthesis. In particular, it produces oxygen without which which we cannot survive. The splitting process involves two ionizations. The ionisation energy of the first electron 12.56 eV and in ultraviolet much above the metabolic energy quantum around.5 eV. How the splitting of water can be achieved at all? This looks like a very real problem!

2. CDs/EZs could be the solution to the problem. Inside CD the energy for the splitting of water is much smaller due to the fact that electrons are almost free as already mentioned: if the splitting energy equals to the so called formation energy, it is about.41 eV for CD: nothing but the metabolic energy quantum! Also at the interace of EZ just above the boundary of EZ the electronic states are excited and only an energy of.51 eV - known as formation energy - is needed for the splitting. This suggests that metabolic energy quanta are used to generate EZs and/or CDs in the fundamental step metabolism. Also irradiation at these energies generates CDs/EZs.

3. My layman logic says that formation energy for EZ must correspond to the energy needed to increase the size of /EZ by a minimum amount. In TGD model this would mean creating one proton-electron pair such that electron remains inside the EZ, whose size thus increases and proton becomes dark proton at dark magnetic flux tube. This step would be also a key

step in the splitting of water. Splitting of water and growth of EZ would be essentially the same process. In the case of CD it would seem that charge separation takes place inside CD in the splitting and proton can go outside.

What comes in mind that the formation of CDs requiring large excitation UV energy of 12.06 eV precedes that of EZs. After the formation of CD and almost free electrons only metabolic energy quantum per proton is required to kick single proton to dark magnetic flux tube. This would conform with the fact that CD radius is about 200 times larger than that of CD meaning that volumes are related by a factor $8 \times 10^6 \simeq 2^{23}$. The formation of EZ would transform tetrahedral water to the hexagonal $H_{1.5}O$ and suck protons to dark protons at magnetic flux tubes. If this picture is correct, the proper identification of formation energy for CD would be as absorption energy for CD equal to 12.06 eV and in UV. Recall that bio-photon spectrum extends to UV and dark photons with this energy could be responsible for the formation of CDs. This would adde dark photons transforming to bio-photons to the picture.

The formation of EZ can be seen as pulling out one ordinary proton from ordinary water just above the surface of the EZ and making it dark proton at a magnetic flux tube assignable to the EZ and perhaps connecting it to neighboring EZ for form a quantum coherent network. Dark proton would serve as a current carrier and make water a conductor and perhaps even super-conductor. Even superfluidity can be considered.

4. The metabolic energy quantum.5 eV can be also assigned with hydrogen bond. Could the process of generating dark proton and increasing the size of EZ by one electron involve cutting of the hydrogen bond binding the proton to the water outside. If so then the only thing keeping the excited water inside CD as a coherent phase would be the bond energy of hydrogen bonds! Maybe this is too simplistic.

   I have proposed earlier that hydrogen bonds are short magnetic flux flux tubes, which can suffer h_{eff} increasing phase transition. These flux tubes could in turn experience reconnections with U shaped large h_{eff} flux tubes and get connected to the dark web. Mae-Wan Ho also tells that the transfer of proton from covalent OH bond to the middle of hydrogen bond happens with a considerable probability. Could this step precede the increase of h_{eff} and reconnection? This would give a connection with hydrogen bonding about which Mae Wan-Ho also talked about. These naive models of course cannot be correct in detail but give hopes about fusion of existing chemical thinking and new quantal notions.

5. A process bringing in mind the formation of EZs occurs as one perturbs molecular bio-systems - that is feeds energy into it. The system "wakes up" from "winter sleep", the globular proteins, which are in resting state with hydrogen bonds at their surface forming kind of ice layer unfold and protein aggregates are formed. Molecular summer begins and ceases when the energy feed is over. Cellular winter begins again. Maybe cellular summer is just temporary formation of EZ layers around the protein involving melting of hydrogen bonds and generation of dark protons making system conscious!

3.3 Is A New Source Of Metabolic Energy Needed?

What remains to be understood is the process generating CDs: where could the UV photons with energy 12.06 eV come? Clearly a new form of metabolism is involved and the only source of energy seems to be the Sun!

1. Solar radiation cannot however provide UV photons as ordinary photons since UV radiation at these wavelengths is absorbed by the atmosphere. In TGD framework a reasonable candidate for dark radiation with energies in UV range is dark cyclotron radiation with energy $E = h_{eff} \times f$: biophotons would be produced in the transformation of dark cyclotron photons to ordinary photons.

2. Could part of solar UV radiation transform to dark UV photons at magnetic flux tubes of even size scales larger than that of Earth predicted by the model of EEG and arrive along them through the atmosphere? The presence of a new source of metabolic energy is in principle a

testable prediction: is the energy feed from the visible part of solar radiation really enough to cover the metabolic energy needs? Here one must however take into account the fact that the UV energy would be received by water. The water from which CDs are eliminated would not allow photosynthesis.

To sum up, if the proposed picture is correct photosynthesis involves formation of EZs and cellular respiration the inverse of this process. As discussed earlier, the purpose of metabolic processes would be basically generation and transfer of negentropic entanglement assignable to large h_{eff} states.

4 Water Memory And Pre-Biotic Life

Pollack's findings [L4] discussed from TGD view point in [K9, K8] provide new insights to the mechanisms of water memory and homeopathy. Also the attempts to understand the dependence of h_{eff} on parameters of the system involved provide help. This picture also suggests a more detailed vision about prebiotic life forms as analogs of exclusion zones involving charge separation leading to large value of h_{eff}.

4.1 Exclusion Zones As Prebiotic Cells

TGD based model model [L4], [K15] for Pollack's findings [L4] provides further guidelines.

1. Pollack et al discovered what they call exclusion zones and fourth gel like phase of water. The phenomenon occurs when water is bounded by gel and is irradiated with say visible light. Exclusion zones are negatively charged regions of water with positively charged environment. They act like batteries and have rather exotic properties. For instance, various impurities are repelled from exclusion zone.

2. The observed $H_{1.5}O$ stoichiometry implies that every fourth proton or hydrogen atom is dark and is transferred to the region outside the negatively charged exclusion zone. If only protons are transferred, very high negative charge density is generated. The size of the exclusion zone varies up to 100 μm and is in the range of cell sizes.

3. Dark matter corresponds in TGD Universe to phases with nonstandard value of Planck constant: $h_{eff} = n \times h$ phases at the "magnetic body" of the system (negatively charged region now). Magnetic body corresponds in Maxwell's theory to the magnetic fields generated by the system. Magnetic body consists of flux quanta (flux tubes and sheets).

4. If dark protons with say size scale of atomic size reside at flux tubes, one can assume that they form strings giving rise to dark atomic nuclei. Also ordinary nuclei consist of strings of dark protons and strings of neutrons. Various impurities are transferred from exclusion zone to the exterior suggesting that they become dark particles at magnetic flux tubes.

5. The quantum states of dark protons consist of 3 quarks and a simple model involving rotational symmetry around the axis of dark proton string predicts that the states of dark proton can be arranged into groups which correspond to DNA, RNA, amino-acids and possibly also tRNA molecules. Vertebrate genetic code can be realized as a natural correspondence between DNA/ RNA and amino-acids [K25, K5].

6. Negatively charged EZ could define a pre-biotic cell so that water would be a primitive prebiotic life form. The voltage would be the analog of the resting potential. The transformation of dark protons to ordinary ones would liberate metabolic energy so that primitive metabolism and photosynthesis would be realized. One can also consider a more general possibility that cyclotron energies are different at flux tube portions in the interior and exterior of the EZ analogous to cell membrane. This would increase the value of the metabolic energy currency by adding to Josephson energy ZeV the difference of dark cyclotron energies proportional to h_{eff}. One expects that dark counterparts of basic bio-polymers are still present in living matter and play a fundamental role.

4.2 TGD View About Homeopathy, Water Memory, And Evolution Of Immune System

The following gives an attempt to build a brief sketch of TGD based model of water memory and homeopathy as it is after the input from Pollack's findings and $h_{eff} = h_{gr} = h_{em}$ hypothesis.

4.2.1 Summary of the basic facts and overall view

A concice summary of the basic qualitative facts about homeopathy [K5] could be following.

1. The manufacture of the homeopathic remedies consists of repeated dilution and agitation of water sample containing the molecules causing the effect which the remedy is intended to heal. This paradoxical looking healing method is based on "Alike likes alike" rule. This rules brings in mind vaccination causing immune system to develop resistance. The procedure seems to somehow store information about the presence of the molecules and this information induces immune response. Usually it is the organisms or molecules causing the disease which induce immune response.

2. The ultra-naive and simplistic objection of skeptic is that the repeated dilution involved with the preparation of homeopathic remedy implies that the density of molecules is so small that the molecules can have absolutely no effect. Despite the fact that we live in information society, this is still the standard reaction of a typical skeptic.

3. A lot of research is done by starting from the natural idea that the electro-magnetic fields associated with the invader molecules (or more complex objects) represent the needed information and that water somehow gets imprinted by these fields. This could for instance mean that water clusters learn to reproduce radiation at frequencies characterizing the invader molecule. Benveniste is one of the most outstanding pioneers in the field [I14]. Benveniste et al [I15] even managed to record the VLF frequency finger print of some bio-active molecules and record them in binary form allowing to to yield the same effect as the real bio-active molecule induced. Benveniste was labelled as a fraud. The procedure used by the journal Nature to decide whether Benveniste is swindler or not brings in mind the times of inquisition. It tells a lot about attitudes of skeptics that magician Randi was one member of the jury!

4. Benveniste's work has been continued and recently HIV Nobelist Montagnier produced what might be regarded as remote replication of DNA using method very similar to that used in manufacturing homeopathic remedy [I22, I23].

The general conclusion is that the em frequencies possibly providing a representation of the molecules are rather low - in VLF region - so that frequencies assignable to molecular transitions are not in question. Cyclotron frequencies assignable to the molecules are the most natural candidates concerning physical interpretation. The corresponding photon energies are extremely low if calculated from $E = hf$ formula of standard quantum mechanics so that quantal effects in the framework of standard quantum theory do not seem to be possible.

My personal interest on water memory was sparked by the work of Cyril Smith [I12]. What I learned was what might be called scaling law of homeopathy [K5]. Somehow low frequency radiation seems to be transformed to high frequency radiation and the ratio $f_h/f_l \simeq 2 \times 10^{11}$ seems to be favored frequency ratio.

These two basic findings suggest what looks now a rather obvious approach to homeopathy in TGD framework. The basic physical objects are the magnetic bodies of the invader molecule and water molecule cluster or whatever it is what mimics the invader molecule. The information about magnetic body is represented by dark cyclotron radiation generated by the invader with frequency f_l. This dark radiation is transformed to ordinary photons with frequency f_h and energy $h_{eff} f_l = h f_h$, which is above thermal energy, most naturally in the range of bio-photon energies so that the radiation can directly induce transitions of bio-molecules. The analogs for the EZs discovered by Pollack are obvious candidates for "water molecule clusters".

The following summarizes this overall picture in more detail.

4.2.2 Dark photon-bio-photon connection

The idea that bio-photons are decay product of dark photons emerged from the model of EEG [K4] in terms of dark photons with energies above thermal energy. Dark photons in question would be emitted as cyclotron radiation by various particles and molecules, perhaps even macromolecules like DNA sequencies. Also cell membrane would emit dark photons with frequencies, which correspond in good approximation to differences of cyclotron energies for large value of $h_{eff} = nh$ [K9, K4].

1. Bio-photons have spectrum in the visible and UV would decay products of dark cyclotron photons. If the h_{eff} of particle is proportional to its mass then the cyclotron energy spectrum is universal and does not depend on the mass of the particle at all. The original model of EEG achieved this by assuming that h_{eff} is proportional to the mass number of the atomic nucleus associated with the ion.

2. The ideas about dark matter involve two threads: $h_{eff} = n \times h$ thread motivated by biology and the thread based on the notion of gravitational Planck constant and inspired by the observation that planetary orbits seem to obey Bohr rules. $\hbar_{gr} = GMm/v_0$ is assigned to the pairs of gravimagnetic flux tubes and massless extremals making possible propagation of dark gravitons. The realization was the two threads can be combined to single thread: by Equivalence Principle h_{gr} hypothesis is needed only for microscopic objects and in this case $h_{eff} = h_{gr}$ makes sense and predicts that dark photon energies and dark particle Compton lengths do not depend on particle and that bio-photon energy spectrum is universal and in the desired range if one assumes that h_{gr} is associated with particle Earth par with v_0 the rotational velocity at the surface of Earth. Even $h_{eff} = h_{em} = h_{gr}$ hypothesis makes sense. $h_{em} = h_{gr}$ is also very natural assumption for ATP synthase which can be regarded as a molecular motor whose rotation velocity appears in the formula for h_{em}.

3. The prediction would be that any charged system connected to Earth by flux tubes generates cyclotron dark photons decaying to bio-photons. Bio-photons in turn induce transitions in biomolecules because the energy range is in visible and UV. Magnetic bodies can control biochemistry via resonant coupling with bio-photons.

4.2.3 Molecular recognition mechanism as basic building brick of primitive immune system

The reconnection of U-shaped magnetic flux tubes emanating from a system makes possible a recognition mechanism involving besides reconnection also resonant interaction via cyclotron radiation which can induced also biochemical transitions of $h_{eff} = h_{gr}$ hypothesis holds true.

1. Molecules have U-shaped flux tube loops with fluxes going in opposite directions. This makes possible also super-conductivity with members of Cooper pair at the parallel flux tubes carrying magnetic fluxes in opposite direction since magnetic fields now stabilize Cooper pairs rather than tend to destroy them.

2. The flux loops associated with systems - call them A and B - can reconnect and this leads to the formation of 2 parallel flux tubes connecting A and B. Stable reconnection suggests that magnetic field strengths must be same at the flux tube pairs associated with A and B. This implies same cyclotron frequencies and resonant interaction. This would define molecular mechanism of recognition and sensing the presence of invader molecules - even conscious directed attention might be involved.

3. Systems with magnetic body could be constantly varying the thicknesses of at least some of their flux tubes and in order to reconnect with the magnetic body of a possible invader. This activity could be behind the evolution of the immune system.

The question is how the system or its sub-system could stabilize itself so that it would receive signals only from one kind of molecule specified by its cyclotron frequency spectrum.

1. If the flux tubes carry monopole flux (this is possible in TGD framework and requires the flux tube cross section is closed 2-surface), stabilization of the flux tube thickness stabilizes

the magnetic field strength. How the stabilization of the thickness of the flux tubes could have been achieved?

Pollack's negatively charged EZs with dark protons at magnetic flux tubes giving rise to dark nuclei identifiable as dark proton sequences suggests an answer. Maybe the presence of dark proton sequences could stabilize the flux tube thickness. Dark proton sequences have also interpretation as dark DNA/RNA/amino-acid sequences [K25].

A further question is whether the magnetic body of the prebiotic cell identified as EZ could use the information about invader molecule to represent its magnetic body either concretely and perhaps even symbolically and regenerate the concrete representation when needed.

1. The concrete representation could be in terms of dark proteins whose folding would represent the topology of the invader molecule and symbolic representation in terms of dark DNA transcribed to dark protein. If the dark protein has same topology of knotting it could more easily attach to the invader molecule and make it harmless. Note that the invaders are naturally other dark DNAs and proteins jus as in living matter. The higher purpose behind this cold war would be stimulation of mimicry - emulation in computer science - leading to generation of cognitive representations and negentropic entanglement.

2. Not only the representation of the 3-D magnetic body - its behavior - is possible. In ZEO also the representation of the dynamical evolution of magnetic body becomes possible since basic objects are pairs of 3-surfaces at future and past boundaries of causal diamond. The challenge is to represent the topology time development of magnetic body - 2-braiding, first concretely by mimicking it and then symbolically in terms of DNA coding for proteins doing the mimicry. The obvious representation for the behavior of magnetic body of invader molecule would be in terms of folding and unfolding of protein representing it.

3. The question how the symbolic representation could have emerged leads to a vision about how genetic code emerged. The model for living system as topological quantum computer utilizing 2-braiding for string world sheets at 4-D space-time leads to the idea that 3-D coordinate grids formed by flux tubes are central for TQC: each node of grid is characterized by 6 bits telling about the topology of the node concerning 2-braiding. Could the 6 bits of dark DNA code for the local topology of the invader molecule and an the flux tube complex mimicking it?

4. This raises the possibility that DNA strands - one for each coordinate line in say z-direction could code for the 2-braiding of 3-D coordinate grid and in this manner code for the magnetic template of invader molecule and also that of the biological body. Therefore genetic code would code for both the basic building bricks of the biological body and 4-D magnetic body serving as template for the development of biological body.

One can imagine how the biochemical evolution after this stage might have taken place.

1. At the next step the chemical representation of genetic code would have emerged. Dark proteins learned to attach to real proteins and real proteins to other proteins and DNA and bio-catalysis became possible.

2. The transformation of the ordinary photons emitted in the transitions of biomolecules to dark photons made possible the recognition of invader molecules using ordinary photons emitted in their molecular transitions.

3. Magnetic bodies learned to control biochemical reactions by using dark cyclotron radiation transformed to bio-photons.

4. Gradually dark and ordinary proteins developed a rich repertoire of functions relying on reconnection, communication by dark photons, and attachment in invader molecule. Proteins began to serve as building bricks, as bio-catalysts, promote the replication of DNA, responding to stimuli, serve as receptors.

4.2.4 Possible mechanism of water memory and homeopathy

The general vision about prebiotic evolution described above suggests that the mechanisms of water memory and homeopathy are basically the same as those underlying the workings of the immune system.

1. Exclusion zones could define primordial life forms with genetic code. They are able to detect the presence of invader molecule from its cyclotron frequency spectrum.

2. Dark proteins can form concrete memory representations of the invader molecules in terms of dark proton sequences defining dark proteins. The folding of these dark proteins mimics the behavior of the magnetic bodies of the invaders. These dark proteins can attach to the magnetic body of the invader molecule to make it non-dangerous. Even symbolic representations in terms of dark DNA allowing transcription and translation to concrete dark protein representation could be involved. The procedure involved in the manufacture of homeopathic remedy could be seen as a series of "environmental catastrophes" driving the evolution of dark primordial life by feeding in metabolic energy and generating new EZs, which mimic the invader molecules and existing EZs mimicking them.

3. In organism the dark DNA representing the invader molecule would generate ordinary genes coding for ordinary proteins attaching to the invader molecules by the attachment of ordinary DNA nucleotides to them. The attachment would involve h_{eff} reducing phase transition reducing the length of connecting flux tube.

4. Later dark genetic code transformed to chemical genetic code as dark DNA strands were formed around dark double strands and large number of other biological functions emerged besides immune response.

5. The mechanical agitation in the manufacturing of homeopathic remedy generates exclusion zones and new primitive life forms by providing the needed energy. These in turn recognize and memorize invader molecules and their already existing representations as EZs.

4.3 Direct Empirical Evidence For Dark DNA?!

Sciencedaily tells about extremely interesting finding related to DNA (`http://tinyurl.com/pbzqx36`. The finding is just what breakthrough discovery should be: it must be something impossible in the existing world view.

What has been found [I24] (`http://tinyurl.com/y9849jkz`) is that knock-out (removing parts of gene to prevent transcription to mRNA) and knock-down of gene (prevent protein translation) seem to have different consequences. Removing parts of gene need not have the expected effect at the level of proteins! Does this mean that somehow DNA as a whole can compensate the effects caused by knock-out but not those by knock-down? This explanation is natural in the standard conceptual framework and is proposed in the article.

Could this be explained by assuming that genome is a hologram as Gariaev et al (`http://tinyurl.com/ycosxzen`) [I16, I3] have first suggested? Also TGD leads to a vision about living system as a conscious hologram [K3]. Small local changes of genes could be compensated. Somehow the entire genome would react like brain to a local brain damage: other regions of brain take the duties of the damaged region. Could the idea about DNA double strand as nano-brain having left and right strands instead of hemispheres"help here. Does DNA indeed act as a macroscopic quantum unit? The problem is that transcription is local rather than holistic process. Something very simple should lurk behind the compensation mechanism.

4.3.1 Could transcription transform dark DNA to dark mRNA?

Also the TGD based notion of dark DNA comes in mind [K5, K25] (`http://tinyurl.com/ybp338x5`, `http://tinyurl.com/yag67j4p`). Dark DNA consists of dark proton sequences for which states of single DNA proton correspond to those of DNA, mRNA, aminoacids, and tRNA. Dark DNA is one of the speculative ideas of TGD inspired quantum biology getting support from Pollack's findings (`http://tinyurl.com/oyhstc2` [L4], [K26]). Ordinary biomolecules would only

make their dark counterparts visible: dark biomolecules would serve as a template around which ordinary biomolecules such as DNA strands are formed in TGD Universe. All basic biomolecules of genetics would be pairs of ordinary biomolecule and its dark proton analog.

Although ordinary DNA is knocked out of ordinary gene, dark gene would still exist! If dark DNA actually serves as template for the transcription to mRNA, everything is still ok after knock-out! Could it be that we do not understand even transcription correctly? Could it actually occur at the level of dark DNA and mRNA?! Dark mRNA would attach to dark DNA after which ordinary mRNA would attach to the dark mRNA. One step more!

Damaged DNA could still do its job! DNA transcription would would have very little to do with bio-chemistry! If this view about DNA transcription is correct, it would suggest a totally new manner to fix DNA damages. These damages could be actually at the level of dark DNA, and the challenge of dark genetic engineering would be to modify dark DNA to achieve a proper functioning.

4.3.2 Could dark genetics help to understand the non-uniqueness of the genetic code?

Also translation could be based on pairing of dark mRNA and dark tRNA. This suggests a fresh perspective to some strange and even ugly looking features of the genetic code. Are DNA and mRNA always paired with their dark variants? Do also amino-acids and anticodons of tRNA pair in this manner with their dark variants? Could the pairings at dark matter level be universal and determined by the pairing of dark amino-acids with the anticodons of dark RNA? Could the anomalies of the code be reduced to the non-uniqueness of the pairing of dark and ordinary variants of basic bio-molecules (pairings RNA–dark RNA, amino-acid– dark amino-acid, and amino-acid–ordinary amino-acid in tRNA).

1. There are several variants of the genetic code differing slightly from each other: correspondence between DNA/mRNA codons and amino-acids is not always the same. Could dark-dark pairings be universal? Could the variations in dark anticodon - anticodon pairing and dark amino-acid-amino-acid pairing in tRNA molecules explain the variations of the genetic code?

2. For some variants of the genetic code a stop codon can code for amino-acid. The explanation at the level of tRNA seems to be the same as in standard framework. For the standard code the stop codons do not have tRNA representatives. If stop codon codes for amino-acids, the stop codon has tRNA representation. But how the mRNA knows that the stop codon is indeed stop codon if the tRNA associated with it is present in the same cell?

   Could it be that stop codon property is determined already at the level of DNA and mRNA? If the dark variant of genuine stop codon is missing in DNA and therefore also in mRNA the translation stops if it is induced from that at the level of dark mRNA. Could also the splicing of mRNA be due to the splitting of dark DNA and dark mRNA? If so genes would be separated from intronic portions of DNA in that they would pair with dark DNA. Could it be that the intronic regions do not pair with their dark counterparts. They would be specialized to topological quantum computations in the TGD inspired proposal [K23].

   Start codon (usually AUG coding met) serves as a Start codon defining the reading frame (there are 3 possible reading frames). Dark DNA would naturally begin from this codon.

3. Also two additional amino-acids Pyl and Sec appear in Nature. Gariaev et al have proposed that the genetic code is context dependent so that the meaning of DNA codon is not always the same. This non-universality could be reduced to the non-uniqueness of dark amino-acid–amino-acid pairing in tRNA if genetic code is universal.

4.3.3 Could dark genetics help to understand wobble base pairing?

Wobble base pairing (`http://tinyurl.com/y73se8vs`) is second not-so-well understood phenomenon. In the standard variant of the code there are 61 mRNAs translated to amino-acids. The number of tRNA anticodons (formed by the pairs of amino-acid and RNA molecules) should be also 61 in order to have 1-1 pairing between tRNA and mRNA. The number of ordinary tRNAs is however smaller than 61 in the sense that the number of RNAs associated with them is smaller than 45. tRNA anticodons must be able to pair with several mRNA codons coding for given amino-acid.

This is possible since tRNA anticodons can be chosen to be representative for the mRNA codons coding a given amino-acid in such that all mRNA codons coding for the same amino-acid pair with at least one tRNA anticodon.

1. This looks somewhat confusing but is actually very simple: genetic code can be seen as a composite of two codes: first 64 DNAs/mRNAs to are coded to $N < 45$ anticodons in tRNA, and then these N anticodons are coded to 20 amino-acids. One must select N anticodon representatives for the mRNAs in the 20 sets of mRNA codons coding for a given amino-acid such that each amino-acid has at least one anticodon representative. A large number of choices is possible and the wobble hypothesis of Crick pose reduce the number of options.

2. The wobble hypothesis of Crick states that the nucleotide in the third codon position of RNA codon of tRNA has the needed non-unique base pairing: this is clear from the high symmetries of the third basis. There is exact U-C symmetry and approximate A-G symmetry with respect to the third basis of RNA codon (note that the conjugates of RNA codons are obtained by A$\leftrightarrow$U and C$\leftrightarrow$G permutations).

3. The first two basis in the codon pair in 1-1 manner to the second and third basis of anticodon. The third basis of anticodon corresponds to the third letter of mRNA codon. If it is A or C the correspondence is assumed to be 1-to-1: this gives 32 tRNAs. If the first basis of anticodon is G or U the 2 mRNA basis can pair with it: they would be naturally A for G and C for U by symmetry. One would select A from A-G doublet and C from U-C double. This would give 16 anticodons: 48 anticodons altogether, which is however larger than 45. Furthermore, this would not give quite the correct code since A-G symmetry is not exact.

   Smaller number of tRNAs is however enough since the code has almost symmetry also with respect to A and C exchange not yet utilized. The trick is to replace in some cases the first basis of anticodon with Inosine I, which pairs with 3 mRNA basis. This replacement is possible only for those amino-acids for which the number of RNAs coding the amino-acid is 3 or larger (the amino-acids coded by 4 or 6 codons).

4. It can be shown at least 32 different tRNAs are needed to realize genetic code by using wobble base pairing. Full A-C and G-U symmetry for the third basis of codon would give 16+16=32 codons. One can ask whether tRNA somehow realizes this full symmetry?

How dark variants of could help to understand wobble base pairing? Suppose for a moment that the visible genetics be a shadow of the dark one and fails to represent it completely. Suppose the pairing of ordinary and dark variants of tRNA anticodons *resp.* amino-acids and that translation proceeds at the level of dark mRNA, dark anticodons, and dark amino-acids, and is made visible by its bio-chemical shadow. Could this allow to gain insights about wobble base pairing? Could the peculiarities of tRNA serve for some other - essentially bio-chemical - purposes?

The basic idea would be simple: chemistry does not determine the pairing but it occurs at the level of the dark mRNA codons and dark tRNA anticodons. There would be no need to reduce wobble phenomenon to biochemistry and the only assumption needed would be that chemistry does not prevent the natural dark pairing producing standard genetic code apart from the modifications implied by non-standard dark amino-acid–amino-acid pairing explaining for different codes and the possibility that stop codon can in some situation pair with dark mRNA.

One can consider two options.

1. The number of dark RNAs is 64 and the pairings between dark mRNA and dark anticodons and dark anticodons and dark amino-acids are 1-to-1 and only the pairing between dark RNA codons and anticodons in tRNA is many-to-1.

2. The model of dark genetic code [K5] suggests that there are 40 dark proton states, which could serve as dark analogs of tRNA. This number is larger than 32 needed to realize the genetic code as a composite code. I have cautiously suggested that the proposed universal code could map dark mRNA states of the same total spin (there is breaking of rotational symmetry to that around the axis of dark proton sequences) to dark tRNA/dark amino-acid states with the same total spin projection. The geometric realization would in terms of color flux tubes connecting the dark protons of corresponding dark proton sequences. Also in

ordinary nuclei the nucleons are proposed to be connected by color flux tubes so that they form nuclear strings [K25] and dark proton sequences would be essentially dark variants of nuclei.

One should understand the details of the dark mRNA–tRNA anticodon correspondence. One can also ask whether the dark genetic code and the code deduced from the icosahedral model for music harmony [K10] [L2] are mutually consistent. This model implies the decomposition of 60+4 DNA codons to 20+20+20+4 codons, where each "20" corresponds to one particular icosahedral Hamilton's cycle with characteristic icosahedral symmetries. "4" can be assigned to tetrahedron regarded either disjoint from icosahedron or glued to it along one of its faces. This allows to understand both the standard code and the code with two stop codons in which exotic amino-acids Pyl and Sec appear. One should understand the compositeness $64 \to 40 \to 20$ of the dark genetic code and and whether it relates to the icosatetrahedral realization of the code.

I have proposed [K6] (`http://tinyurl.com/ycm48w54`) that dark variants of transcription, translation, etc.. can occur and make possible kind of R&D laboratory so that organisms can test the consequences of variations of DNA. If ordinary translation and transcription are induced from their dark variants it would not be surprising and if dark biomolecules could also appear as unpaired variants, these processes could occur as purely dark variants. Organisms could indeed do experimentation in the virtual world model of biology and pairing with ordinary bio-molecules would make things real.

There is now evidence for this picture. It has been discovered [J2] (`http://tinyurl.com/oec3mff`) that brain cells have a mosaic like distribution of genomes (`http://tinyurl.com/odwajdq`) . In standard framework this mosaic should be created by random mutations. The mechanism of mutation is reported to involve transcription rather than DNA replication. The mutation would take place for DNA when its is copied to RNA after opening of the DNA double strand. The mutations would have occurred during the period when neurons replicate and the mutation history can be read by studying the distributions of changes in the genome.

This brings in mind the finding that removing a part of gene does not affect transcription. In both cases it is dark DNA, which would serve as a template for transcription rather than ordinary DNA. This suggests that the dark DNA is not changed in these modifications and mRNA is determined by the dark DNA, which would serve as a template for transcription rather than ordinary DNA. If this were the case also for neurons, the mutations of neuronal genes should not affect the gene transcription at all, and there would be no negative (or positive) effects on brain function. This seems too conservative. The mutations should have some more active role.

One can consider also different interpretation. The mutations of DNA could be induced by the dark DNA. As dark DNA changes, ordinary DNA associated with it is forced to change too - sooner or later. Especially so when the genome is in a state in which mutations can take place easily. Neurons during to replication stage could have such quantum critical genomes.

Evolution would not be mere selection by a survival of random mutations by external environment in the time scale much longer than lifetime of individual - but a controlled process, which can occur in time scale shorter than lifetime and differently inside parts of say brain. This is what the idea TGD inspired biology suggests. The modified DNA could be dark DNA and and serve as template for transcription and also induce transformation of ordinary DNA associated with it.

Whether this change can be transferred to the germ cells to be transferred to the offspring remains of course an open question. For instance, one can imagine that dark DNA strands (magnetic flux tubes) can penetrate germ cell membranes and replace the earlier dark DNA sections and induce change of ordinary DNA. Or is a more delicate mechanism involving dark photons in question. With inspiration coming from the findings reported by Peter Gariaev [I16] I have proposed a model of remote DNA replication suggesting that DNA can be replicated remotely if the needed nucleotides are present [K30]: the information about DNA could be transferred as dark photons, which can be transformed to ordinary photons identified as bio-photons. Could Lysenko have been at least partially right despite that he was a swindler basing his views on ideology?

In any case, TGD inspired biology allows to imagine a controlled evolution of DNA in analogy to that what occurs in R&D departments of modern technological organizations. The notion of dark DNA suggests that biological systems indeed have a "R&D department" in which new variants of DNA studied as "dark DNA" sequences realised as dark proton sequences - same about dark RNA, and amino-acids and even tRNA. The possibility to transcribe RNA from dark DNA would

mean that the testing can be carried in real life situations.

There indeed exists evidence that traumatic - and thus highly emotional - memories may be passed down through generations in genome [J1] (`http://tinyurl.com/oja8v94`). Could the modifications of brain DNA represent long term memories as the above described experiment suggests? Could the memories be transferred to the germ cells using the mechanism sketched above?

4.4 Is Replication Of Magnetic Body Behind Biological Replication?

The vision about exclusion zone (EZ) like regions as primordial life forms and facts about water memory and homeopathy lead to a vision about how primitive immune system might have developed and how the recent genetic code might have emerged.

Magnetic body and dark analogs of bio-polymers should still play key role in living matter. The basic idea is that the time evolution of the magnetic body is the template for the time evolution of the biological body. In [K16] [L3] various pieces of evidence for the role of magnetic body as "morphogenetic field" are discussed. For instance, the replication of DNA and cell would reduce basically to that for corresponding magnetic bodies.

Replication of magnetic body is analogous to what happens in 3-vertex of Feynman diagram. This occurs in several scales. This would make possible dark DNA (dDNA) replication and copying of dDNA to dDNA+dRNA as well as copying of dRNA to dRNA+dark protein.

Replication process should start from the higher levels of dark matter hierarchy and proceed to shorter scales. The basic constraint from ZEO is that the time evolutions of magnetic bodies at various levels of the hierarchy are highly unique as preferred extremals connecting initial and final 3-surfaces. For the maxima of vacuum functional only preferred pairs of 3-surfaces are possible. This gives rise to what might be called "standard behaviors". Also the replication would be this kind of behavioral pattern. In the context of the positive energy ontology it is extremely difficult to understand why the predictability of cell replication or the development of organism from single cell by repeated cell divisions.

Remote gene replication [K30] might be one application: the model described was actually developed before the idea that the replication of the magnetic body could be the fundamental mechanism. Its reversal could be basic mechanism of bio-catalysis and induce the attachement of bio-molecules together. Also ordinary DNA replication could be induced by the same electromagnetic signal as remote replication.

The sketch about replication of DNA would look roughly like following.

1. Assume that the portion of DNA promoting DNA replication is activated by dark radiation at some frequency and that the promoter region emits radiation with same frequency. This activates further promoter regions -also in other cell nuclei. The replication process is amplified exponentially. The negative feedback is necessary in the general case and is provided by attachment of the produced proteins (basically dark proteins) to the genes making them inactive.

2. This might occur during cell division which might involve irradiation by dark analog of white noise exciting all promoter regions. Certainly the coherence of this process is essential and here the higher levels of the dark matter hierarchy would be essential.

3. Remote replication becomes possible if the dark radiation exciting promoter region can leak to other cells or even other organisms. Large h_{eff} might make this possible.

4. Also remote transcription is possible by the same mechanism. Actually remote variants of very many basic processes seem to be possible.

5. The observations of Peter Gariaev's group bout effects of laser light on genes [I17, I29] support this view as also the findings of group of HIV Nobelist Montagnier [I22, I23].

4.5 Quantum Model For Metabolism

First it is good to list some basic facts about energy metabolism.

1. ADP→ ATP meaning the addition of phosphate to ADP is believed to be the fundamental step of metabolism. The process occurs when protons flow through the ATP synthase, which can be regarded as a nano-motor with a rotating shaft. During single turn three ADPs are phosphorylated and 3 protons flow through the "turbine" of the nano-motor and give up their Coulombic and chemical energy parameterized in terms of chemical potential difference. There is clearly a strong analogy with power plant. High energy phosphate bond is believed to receive the metabolic energy transferred from the flow of protons through the mitochondrial membrane.

2. The nominal value of metabolic energy quantum about.5 eV. The Coulomb energy associated with the mitochondrial membrane is 50-80 meV and by almost order of magnitude too small. The large chemical potential difference is believed to explain the large metabolic energy gain. This requires that the process is regarded as purely thermodynamical. This is a questionable assumption even in standard physics context and does not conform with the TGD based idea that transmembrane proteins such as ATP synthase act as large h_{eff} Josephson junctions. The square root of thermodynamics forced by zero energy ontology suggests itself as a proper description of cell membrane as macroscopically quantum coherent system.

3. The notion of high energy phosphate bond is not well understood. The storage of energy dark cyclotron energy at the magnetic body of phosphate suggests itself as TGD based description.

4.5.1 How to understand the value of $heff$?

The basis problem is to understand how h_{eff} depends on the parameters characterizing the situation at the magnetic flux tube connecting two systems. I have considered several mechanisms for the generation of large h_{eff} phase.

1. The model for h_{eff} in systems involving charge separation stimulated by AC current was based on the identification of Josephson frequency with the frequency of AC current: $f_J = E_J/h_{eff} = f_{AC}$ predicting $h_{eff}/h = E_J/hf_{AC}$ [K17].

   The findings of Pollack and the difficulties to understand metabolic energy quantum of nominal value.5 eV in the simplest model for cell membrane as Josephson junction as Josephson energy for Cooper pair equalto to $ZeV = 10-10.6$ mV inspired the assumption that cyclotron energies at flux tubes traversing cell membrane can be different at the two sides of the cell membrane [K4, K9]. This would lead to a generalization of the notion of Josephson junction associated with the transmembrane protein and generalizes $f_J = f_{AC}$ to $\Delta f_c + f_J = f_AC$ predicting $h_{eff}/h = E_J/(h(\Delta f_c - f_{AC})$ so that h_{eff}/h would get arbitrarily large values near resonance $f_{AC} = f_C$. Note that correct sign requires $\Delta f_C - f_{AC} > 0$.

2. The conjecture $\hbar_{eff} = \hbar_{gr} = GMm/v_0$ could make sense at microscopic level for particle-Earth pair and would predict a universal spectrum of bio-photons if identified as resulting from the decays of dark cyclotron photons to bio-photons. The first guess for the parameter v_0 would be as a rotational velocity associated with the two systems such as Earth and electron rotating with it. In case of planetary orbits $v = v_0$ is not consistent with

   $$\frac{v}{c} = \frac{\sqrt{\frac{v_0}{c}}}{4\pi n}$$

   following from Bohr rules in $1/r$ potential (n denotes the principal quantum number).

3. $h_{eff} = h_{em} = Z_1Z_2e^2/v_0$ hypothesis is a natural looking generalization in systems involve large charge separations, say the exclusion zones discovered by Pollack providing a model for prebiotic life forms. The philosophy would be that when the coupling strength between systems becomes so large that perturbation theory fails, the value of h_{eff} increases and makes perturbation theory is in powers of $1/h_{eff}$) possible again. At space-time level this means emergence of non-determinism so that 3-surfaces at the future and past boundaries of causal diamond are connected by n-branched space-time surface for which branches fuse at the two ends. Dark matter would be Nature's manner to define what non-perturbative phases are. The strong hypothesis $h_{eff} = h_{em} = h_{gr}$ might make possible reconnection between em and gravimagnetic flux tubes and ATP synthase is here a candidate system.

4. Rotating magnetic systems with high negative charge are also good candidates for generating large h_{eff} at the magnetic flux tubes possibly contain dark proton sequences identifiable as dark nuclei. I have also proposed that a system subject to constant torque allowing description in terms of potential function which is multivalued as function of the angle coordinate ϕ leads rather naturally to generation of large h_{eff} [K6] when one requires internal consistency.

4.5.2 How metabolic energy is transferred?

The basic question concerns the mechanism of energy transfer from nutrients. It should be however emphasized that the transfer might not be the really important aspect. The transfer of negentropic entanglement from nutrient to the organism might be of equal importance.

1. Zero energy ontology (ZEO) suggests that magnetic bodies are carriers of the metabolic energy. What does this mean is not quite clear but cyclotron energies or ions or Cooper pairs of them proportional to h_{eff} are obvious candidates concerning energy storage. The value of $h_{eff} \simeq 10^{14}$ guaranteeing the energies of dark EEG photons are in the range of bio-photon energies would mean that storage as cyclotron energies is very effective and the liberated energy quanta can directly induce molecular transitions essential for bio-chemical reactions.

2. The liberation of metabolic energy could take place in a phase transition in which p-adic length scale increases and h_{eff} is reduced in such a manner that the length of flux tubes is not changed. This induces a coherent quantum transition in the sense that large number of particles can liberate cyclotron energy as cyclotron energy scale is reduced in the reduction of magnetic field strength. As protons flow from thinner flux tube with smaller h_{eff} to thicker one, similar reduction of cyclotron energy takes place and the energy is liberated, and would be received by ATP synthase to form ATP from ADP. This mechanism could be universal and at work also in other situations.

3. At quantitative level the identification $h_{eff} = h_{gr}$ of gravitational Planck constant with $h_{eff} = n \times h$ at microscopic level at least is an attractive hypothesis [K28, K9]. Gravitational Planck constant can be expressed as $\hbar_{gr} = GMm/v_0$, where v_0 is taken to be the rotational velocity of Earth. Assuming this for Cooper pairs of rotating super-conductor explains the gravimagnetic anomaly claimed by Tajmar et al [E2, E4]. It also predicts a universal energy spectrum of dark cyclotron photons in the range of bio-photon energies and gives thus support for the hypothesis that dark EEG photons decay to bio-photons. The metabolic energy quantum for proton of order.5 eV is consistent with the identification as cyclotron energy difference for proton over mitochondrial membrane. The hypothesis $h_{em} = h_{eff} = h_{gr}$ makes also sense for the nano-motor defined by ATP synthase transforming ADP to ATP.The interpretation would be that this condition makes possible the reconnection of electromagnetic and gravitational flux tubes.

One can imagine also different scenario involving phase transition changing the value of h_{eff} assignable to atoms. TGD indeed predicts also small values of h_{eff}. $h_{eff} = h_{em}$ would hold true when em interaction becomes non-perturbative. In this case NE would be short ranged and associated with atomic/molecular systems with nonstandard value of h_{eff}.

1. For dark atoms the scale of binding energy behaves like $1/h_{eff}^2$ and is thus reduced for dark atoms [K20]. The creation of dark atoms would require metabolic energy. This metabolic energy could also be liberated as dark atoms transforms to ordinary atom. Metabolic electrons could be associated with dark atoms and also the dark atoms in nutrients could provide metabolic energy driving protons through the mitochondrial membrane against potential gradient and transforming ADP to ATP contains high energy phosphate bond, which would actually correspond to the presence of dark (say hydrogen -) atom. Phosphate containing the dark atom would carry the negentropic entanglement or be accompanied by dark magnetic flux tube.

2. 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. There is a large number of alternative identifications for NE. It could be short range entanglement associated with $h_{eff} = h_{em}$ assignable to electron and nucleus of dark atoms, to pairs of atoms or molecules, or very long range entanglement between molecule and large scale structure with size scale of Earth or even galaxy and associated with $h_{eff} = h_{gr}$. Both forms of NE might be involved and distinguish between two evolutionary levels.

3. Short ranged NE could be associated with dark atoms for which the scale of binding energy behaves like $1/h_{eff}^2$ and is thus reduced for dark atoms [K20]. The creation of dark atoms would require metabolic energy. This metabolic energy could also be liberated as dark atoms transforms to ordinary atom. The dark atoms in nutrients transforming to ordinary atoms could provide the metabolic energy driving protons through the mitochondrial membrane against potential gradient and transforming ADP to ATP contains high energy phosphate bond, which would actually correspond to the presence of dark (say hydrogen -) atom. Phosphate containing the dark atom would carry the NE or be accompanied by dark magnetic flux tube. The transfer of NE would mean its disappearance followed by reappearance and it could happen that $h_{eff}/h = n$ is reduced in the process.

4. The simplest view about photosynthesis would be that the absorption of solar photons excites some atoms to dark states and that nutrients contain these dark atoms as stable enough entities. The contamination of nutrients could mean the decay of these dark atoms to the normal states.

4.5.3 Exclusion zones as prebiotic cells

TGD based model model [L4], [K15] for Pollack's findings [L4] provides further guidelines.

1. Pollack et al discovered what they call exclusion zones and fourth gel like phase of water. The phenomenon occurs when water is bounded by gel and is irradiated with say visible light. Exclusion zones are negatively charged regions of water with positively charged environment. They act like batteries and have rather exotic properties. For instance, various impurities are repelled from exclusion zone.

2. The observed $H_{1.5}O$ stoichiometry implies that every fourth proton or hydrogen atom is dark and is transferred to the region outside the negatively charged exclusion zone. If only protons are transferred, very high negative charge density is generated. The size of the exclusion zone varies up to 100 μm and is in the range of cell sizes.

3. Dark matter corresponds in TGD Universe to phases with nonstandard value of Planck constant: $h_{eff} = n \times h$ phases at the "magnetic body" of the system (negatively charged region now). Magnetic body corresponds in Maxwell's theory to the magnetic fields generated by the system. Magnetic body consists of flux quanta (flux tubes and sheets).

4. If dark protons with say size scale of atomic size reside at flux tubes, one can assume that they form strings giving rise to dark atomic nuclei. Also ordinary nuclei consist of strings of dark protons and strings of neutrons. Various impurities are transferred from exclusion zone to the exterior suggesting that they become dark particles at magnetic flux tubes.

5. The quantum states of dark protons consist of 3 quarks and a simple model involving rotational symmetry around the axis of dark proton string predicts that the states of dark proton can be arranged into groups which correspond to DNA, RNA, amino-acids and possibly also tRNA molecules. Vertebrate genetic code can be realized as a natural correspondence between DNA/ RNA and amino-acids [K25, K5].

6. Negatively charged EZ could define a pre-biotic cell so that water would be a primitive prebiotic life form. The voltage would be the analog of the resting potential. The transformation of dark protons to ordinary ones would liberate metabolic energy so that primitive metabolism and photosynthesis would be realized. One can also consider a more general possibility that cyclotron energies are different at flux tube portions in the interior and exterior of the EZ

analogous to cell membrane. This would increase the value of the metabolic energy currency by adding to Josephson energy ZeV the difference of dark cyclotron energies proportional to h_{eff}. One expects that dark counterparts of basic bio-polymers are still present in living matter and play a fundamental role.

4.5.4 What might happen in ADP→ ATP process?

The identification of the exclusion zone with magnetic body as a basic structure allows to speculate about what might happen in ADP → ATP process and how ATP might store metabolic energy.

1. The strings of dark protons [K5] would be analogous to basic bio-polymers serving as the basic fuel of metabolics hydrolysed in metabolism. Basic biopolymers tend to be negatively charged and could therefore be accompanied by dark proton strings and the liberated metabolic energy might be stored by these strings as cyclotron energy and as Coulomb energy.

2. The simplest guess is that metabolism has developed from the transformation of dark protons to ordinary ones as the analog of EZ transforms back to ordinary water and potential potential difference disappears. One cana also consider generalizations of this picture. A phase transition reducing h_{eff} and increasing p-adic scale such that the size scale of the flux tube remains fixed but cyclotron energy is reduced. This phase transition could also effectively accompany the flow of protons through the boundary of EZ if h_{eff} is smaller and p-adic scale longer at the other side. This mechanism could be stilla at work at the level of mitochondria for dark protons.

3. The notion of high energy phosphate bond is somewhat mysterious. ATP is negatively charged and one can wonder whether it could be accompanied by EZ assignable to the negatively charged phosphates. Also DNA strands and many other biomolecules carry negative charge due to the phosphates. Could the metabolic energy be stored to the magneti body of ATP or of phosphate and eventually liberated by flow of protons to flux tubes with weaker magnetic field?

One can ask why the rotation of ATP synthase motor is necessary. Could the centrifugal acceleration drive dark particles to the magnetic body or keep them there thus stabilizing the dark phase? The dark protons at the magnetic body rotating with the system would remain to magnetic body and would avoid transition to ordinary protons if it is induced by the vicinity of ordinary protons serving as seeds for phase transition. If this interpretation is in the right direction, the rotating magnetic systems might provide a manner to create dark matter [K1].

4.5.5 Energy metabolism as transfer of negentropic entanglement?

Negentropic entanglement (NE, see **Fig.** `http://tgdtheory.fi/appfigures/cat.jpg` or **Fig. ??** in the appendix of this book) is 2-particle property (or more generally $n > 1$-particle property). One can argue that this is not consistent with the naive idea about systems carrying NE as a resource analogous to metabolic energy. If negentropy transfer is behind metabolism and if one accepts this objection, one must ask whether metabolism actually corresponds to a transfer of NE between nutrient A and some fixed system B so that NE transforms to that between receiver R and same fixed system B? If so, could this could B correspond some higher collective level of consciousness perhaps identifiable as gravitational Mother Gaia (MG) as suggested by the success of $h_{gr} = h_{eff}$ hypothesis at microscopic level?

1. Negentropic entanglement (NE) would be transferred. Nutrients would be negentropically entangled with something very crucial for life. MG is a good candidate in this respect. Even Sun can be considered. Gravitational NE with MG would make possible dark EEG, etc... Basic formula is $\hbar_{gr} = GMm/v_0$, v_0 the rotational velocity at surface at the surface of Earth.

2. Formula generalizes to em case: $h_{em} = Z_1 Z_2 e^2/v_0$ and would apply to ATP synthase being consistent with $h_{gr} = h_{em} = h_{eff}$. Em flux tubes could reconnect with gravitational flux tubes for $h_{gr} = h_{em}$.

3. Nutrient-MG NE can be transformed to molecule-MG NE by the sequence N-MG → P-MG → ATP-MG → R-MG (N for nutrient, R for receiver).

4. The basic mechanism would be the reconnection of magnetic U-shaped loops associated with various molecules serving as kind of tentacles: N/P/ADP/R would have this kind of loops.

One can represent a critical comment. The notion of personal magnetic body (PMB) controlling biological body (BB) is central for TGD inspired theory of consciousness. The above argument does not involve it at all. Can the notion of PMB be therefore consistent with MG hypothesis? Or is PMB in some sense part of the magnetic body of MG - say in the sense that the flux tubes of PMB could be inside flux tubes of MG? Mystics would perhaps equate MG with PMB but this leads to paradoxes.

1. An attractive guess is that $h_{em} = h_{gr}$ holds true for PMB so that it can interact with MG by forming reconnections. Nutrients are dead but have NE with MG so that metabolism allows BB to have NE with MG.

2. How PMB could generate NE with BB? Could it reconnect with the flux tube pairs connecting MG with BB? Do both MG and PMB have NE with BB during life-time. What happens in biological death?: does the NE between PMB and BB transform to that between BB and MG again and only the NE between PMB and MG remains? This would conform with what spiritual teachings say.

3. If the answers to these questions are "yes", the basic purpose of metabolism would be the transformation of gravitational NE between MG and nutrients to that between MG and biomolecules. Magnetic bodies would "steal" part of this NE by reconnecting between MG and BB to that between PMB and BB: note that this process would be something new besides molecular metabolism and could be interpreted as a higher level metabolism. All this would be basically transfer of information from collective level of consciousness to lower levels to be processed and further enriched and to be returned back to MG in biological death: nothing would lost! Biological death itself would be reconnection transforming flux tube bonds to PMB to bonds to MG.

4.5.6 Could electrons serve as nutrients?

The New Scientist article (see `http://tinyurl.com/ybd4g2kl`) about bacteria using electrons as nutrients is very interesting reading since the reported phenomenon might serve as a test for the TGD inspired idea about metabolism as a transfer of negentropic entanglement (NE, see **Fig.** `http://tgdtheory.fi/appfigures/cat.jpg` or **Fig. ??** in the appendix of this book) at fundamental level discussed in [K9] (see `http://tinyurl.com/yat9bx9j`).

1. NE is always between two systems: nutrient and something, call it X. The proposal inspired by a numerical co-incidence was that X could be what I have called Mother Gaia. X could be also something else, say personal magnetic body. The starting point was the claim that the anomalously high mass of electronic Cooper pair in rotating supercounductor (slightly larger than the sum of electron masses!) could be due to a gravimagnetic effects which is however too strong by a factor 10^{28}. This claim was made by a respected group of scientists. Since the effect is proportional to the gravimagnetic Thomson field proportional to the square of Planck constant, the obvious TGD inspired explanation would be $h_{eff} \simeq 10^{14}$ (see `http://tinyurl.com/yb7rsct5` and `http://tinyurl.com/yat9bx9`).

2. Gravitational Planck constant $\hbar_{gr} = GMm/v_0$, v_0 typical velocity in system consisting of masses $M >> m$ and m was introduced originally by Nottale and I proposed that it is genuine Planck constant assignable to flux tubes mediating gravitational interaction between M and m. In the recent case v_0 could be the rotating velocity of Earth around its axis at the surface of Earth.

3. For electron, ions, molecules, .. the value of h_{gr} would of the order of 10^{14} required by the gravimagnetic anomaly and is also of the same order as $h_{eff} = n \times h$ needed by the

hypothesis that cyclotron energies for these particles are universal (no mass dependence) and in the visible and UV range assigned to biophotons. Biophotons would result from dark photons via phase transition. This leads to the hypothesis $h_{eff} = h_{gr}$ unifying the two proposals for the hierarchy of Planck constants at least in microscopic scales.

Thanks to Equivalence Principle implying that gravitational Compton length does not depend on particle's mass, Nottale's findings can be understood if h_{gr} hypothesis holds true only in microscopic scales. This would mean that gravitation in planetery system is mediated by flux tubes attached to particles. One non-trivial implication is that graviton radiation is dark so that single graviton carries much larger energy than in GRT based theory. The decay of dark gravitons to ordinary gravitons would produce bunches of ordinary gravitons rather than continuous stream: maybe this could serve as an experimental signature. Gravitational radiation from pulsars is just at the verge of detection if it is what GRT predicts. TGD would predict pulsed character and this might prevent its identification if based on GRT based belief system.

4. In the recent case the model would say that the electrons serving as nutrients have this kind of negentropic entanglement with Mother Gaia. $h_{gr} = h_{eff}$ would be of order 10^8. Also in nutrients electrons would be the negentropically entangled entities. If the model is correct, nutrient electrons would be dark and could also form Cooper pairs. This might serve as the eventual test.

This is not the only model that one can imagine. TGD predicts also small values of h_{eff}. $h_{eff} = h_{em}$ would hold true when em interaction becomes non-perturbative. In this case NE would be short ranged and associated with atomic/molecular systems. At this moment one cannot exclude the possibility that only short range NE is involved with living matter.

Short ranged NE could be associated with dark atoms for which the scale of binding energy behaves like $1/h_{eff}^2$ and is thus reduced for dark atoms [K20]. The creation of dark atoms would require metabolic energy. This metabolic energy could also be liberated as dark atoms transforms to ordinary atom. Metabolic electrons could be associated with dark atoms and also the dark atoms in nutrients could provide metabolic energy driving protons through the mitochondrial membrane against potential gradient and transforming ADP to ATP contains high energy phosphate bond, which would actually correspond to the presence of dark (say hydrogen -) atom. Phosphate containing the dark atom would carry the negentropic entanglement or be accompanied by dark magnetic flux tube.

Electrons are certainly fundamental for living matter in TGD Universe.

1. Cell membrane is high T_c electronic super-conductor [K9]. Members of Cooper pairs are at flux tubes carrying opposite magnetic fields so that the magnetic interaction energy produces very large binding energy for the large values of h_{eff} involved: of the order of electron volts! This is also the TGD based general mechanism of high T_c superconductivity: it is now accepted that anti ferromagnetism is crucial and flux tubes carrying fluxes at opposite directions is indeed very antiferromagnetic kind of thing.

2. Josephson energy is proportional to membrane voltage ($E_J = 2eV$) is just above the thermal energy at room temperature meaning minimal metabolic costs.

3. Electron's secondary p-adic time scale is.1 seconds, the fundamental biorhythm which corresponds to 10 Hz alpha resonance.

4.6 Humble Origins Of DNA As Nutrient - Really Humble?

I received an interesting link (`http://tinyurl.com/ybv8xu9uDNA_May_Have_Had_Humble_Beginnings_As_Nutrient_Carrier_999.html`) about the indications that DNA may have had rather humble beginnings: it would have served as a nutrient carrier [I26]. Each nucleotide in the phosphate-deoxiribose backbone corresponds to a phosphate and nutrient refers to phosphate assumed to carry metabolic energy in high energy phosphate bond.

In AXP, X=M, D, T the number of phosphates is 1, 2, 3. When ATP transforms to ADP, it gives away one phosphate to the acceptor molecule which receives thus metabolic energy. For DNA there is one phosphate per nucleotide and besides A also T, G, and C are possible.

The attribute "humble" reflects of course the recent view about the role of nutrients and metabolic energy. It is just ordered energy what they are carrying. TGD view about life suggest that "humble" is quite too humble an attribute.

1. The basic notion is potentially conscious information. This is realized as negentropic entanglement for which entanglement probabilities must be rational numbers (or possibly also algebraic numbers in some algebraic extension of rationals) so that their p-adic norms make sense. The entanglement entropy associated with the density matrix characterizing entanglement is defined by a modification of Shannon formula by replacing the probabilities in the argument of the logarithm with their p-adic norms and finding the prime for which the entropy is smallest. The entanglement entropy defined in this manner can be and is negative unlike the usual Shannon entropy. The interpretation is as information associated with entanglement. Second law is not violated since the information is 2-particle property whereas as Shannon entropy is single particle property characterizing average particle.

   The interpretation of negentropic entanglement is as potentially conscious information: the superposition of pairs of states would represent abstraction or rule whose instances would be the pairs of states. The large the number of pairs, the higher the abstraction level.

2. The consistency with standard quantum measurement theory gives strong constraints on the form of the negentropic entanglement. The key notion is that if density matrix is proportional to unit matrix, standard measurement theory says nothing about the outcome of measurement and entanglement can be preserved. Otherwise the reduction occurs to one of the states involved. This situation could correspond to negentropic 2-particle entanglement. For several subsystems each subsystem-complement pair would have similar density matrix. There is also a connection with dark matter identified as phases with non-standard value $h_{eff} = n \times h$ of Planck constant. n defines the dimension of the density matrix. Thus dark matter at magnetic flux quanta would make living matter living.

   In 2-particle case the entanglement coefficients form a unitary matrix typically involved with quantum computing systems. DNA-cell membrane system is indeed assumed to form a topological quantum computer in TGD framework. The braiding of magnetic flux tubes connecting nucleotides with lipids of the cell membrane defines topological quantum computer program and its time evolution is induced by the flow of lipids forming a 2-D liquid crystal. This flow can be induced by nearby events and also by nerve pulses.

   Side-step: Actually pairs of flux tubes are involved to make high temperature superconductivity possible with members of Cooper pairs at flux tubes with same or opposite directions of spins depending on the direction of magnetic field and thus in spin $S = 0$ or $S = 1$ state. For large value of Planck constant $h_{eff} = n \times h$ the spin-spin interaction energy is large and could correspond in living matter to energies of visible light.

3. Negentropy Maximization Principle (NMP, [K7]) is the basic variational principle of TGD inspired theory of consciousness. NMP states that the gain of negentropic entanglement is maximal in state function reduction so that negentropic entanglement can be stable.

4. NMP guarantees that during evolution by quantum jumps recreating the Universe (and sub-Universes assignable to causal diamonds (CDs)) the information resources of Universe increase. Just to irritate skeptics and also to give respect for the ancient thinkers I have spoken about "Akashic records". Akashic records can be said to form books in a universal library and could be read by interaction free quantum measurement preserving entanglement but generating secondary state function reductions providing conscious information about Akashic records defining also a model of self.

   Side-step: Self can be identified as a sequence of state function for which only first quantum is non-trivial at second boundary of CD whereas other quantum jumps induce change of superposition of CDs at the opposite boundary and states at them). Essentially a discretized counterpart of unitary time development would be in question. This allows to understand how the arrow of psychological time emerges and why the contents of sensory experience is about so narrow a time interval. Act of free will corresponds to the first state function reduction at opposite boundary and thus involves change of the arrow of psychological time

at some level of self hierarchy: this prediction is consistent with the Libet's findings that conscious decision implies neural activity initiated before the decision ("before" with respect to geometric time, not subjective time).

In this framework the phosphates could be seen as ends of magnetic flux tubes connecting DNA to cell membrane and mediating negentropic entanglement with the cell membrane. DNA as topological quantum computer vision conforms with the interpretation DNA-cell membrane system as "Akaschic records". This role of DNA-cell membrane system would have emerged already before the metabolic machinery, whose function would be to transfer the entanglement of nutrient molecules with some bigger system X to that between biomolecules and X. Some intriguing numerical co-incidences suggest that X could be gravitational Mother Gaia and flux tubes mediating gravitational interaction with nutrient molecules and gravitational Mother Gaia could be in question [K26]. This brings in mind Penrose's proposal about the role of quantum gravity. TGD is indeed a theory of quantum gravity predicting that gravitation is quantal in astroscopic length scales.

5 A model of protocell based on Pollack effect

I learned about extremely interesting Quanta Magazine article (`http://tinyurl.com/y34o784j`) telling about findings related to water droplets as protocells able to perform chemical metabolism as a transfer of molecules to exterior and back. See

The work is carried out by David Zwicker and collaborators at the Max Planck Institute for the Physics of Complex Systems and the Max Planck Institute of Molecular Cell Biology and Genetics, both in Dresden. The report about the work is published in Nature Physics.

In a simplified model for the droplets (P-granules in C-elegans cell is the real life example) the proteins in droplet can be in two states: in state A the stay in droplet and do not get out but can enter to the droplet from outside. In state B they can get out from droplet. To get into state B energy such as sunlight would be required.

TGD suggests a concrete counterpart for the droplet as exclusion zones (EZs) induced by energy feed such as radiation in water in Pollack effect. EZs are able remove inpurities from interior in conflict with second law. TGD based explanation of the mystery is change of the arrow of time induced by TGD counterpart of ordinary state function reduction in zero energy ontology (ZEO): self-organization would be dissipation with reversed arrow of time at at the magnetic body (MB) of system acting as master and forcing time reversed evolution at the level of ordinary bio-matter serving as a slave.

5.1 TGD based model

TGD suggests for the model of protocell as droplet a realization as exclusion zone (EZ) generated in Pollack effect.

1. The exclusion zones (EZs) discovered by Pollack [I33, I31, I9, I28, L4] (`http://tinyurl.com/oyhstc2`) behave just like this. TGD allows to build a model of the Pollack effect [L4] (`http://tinyurl.com/gwasd8o`). The formation of EZs requires water bounded by a gel phase and they are negatively charged. Their really strange feature is that they throw out impurities just like state B in the model: this seems to defy second law telling that gradients tend to disappear. This makes possible primitive chemical metabolism involving exchange of chemicals between droplet and exterior. Light signal initiating the transfer by providing the metabolic energy needed. Transfer would stop as light signal stops.

   In TGD inspired quantum biology EZs are in crucial role. For instance, cell is negatively charged as also DNA double strand. Interpretation as EZs is natural.

2. The explanation for the negative charge of EZ is that part of protons and possibly other ions go to magnetic flux tubes forming the magnetic body (MB) of the system [L15, L17] (`http://tinyurl.com/yyyk6fu8` and `http://tinyurl.com/yjhx9xp7`). Dark ions form phases with nonstandard value $h_{eff} = n \times h_0 > h$ of effective Planck constant as cyclotron Bose-Einstein condensates. This system has long length scale quantum coherence and serves as

a master controlling bio-chemistry, which is in the role of slave. This forces the mysterious coherence of the ordinary bio-matter impossible in life-as-mere-chemistry approach.

3. MB could control chemical metabolism of the droplet by sending dark photons to the droplet transforming to bio-photons and generating EZ state in the droplet and initiating transfer of molecules to the outside. The transition reducing the value of h_{eff} at MB would bring protons back to EZ droplet and it would become normal again. Secpnd law would force the molecules from outside to diffuse back to the droplet.

4. There is still one hard problem to be solved. What causes the mysterious removal of impurities from EZ challenging second law? Here zero energy ontology (ZEO) comes in rescue [L18] (`http://tinyurl.com/wd7sszo`). In ZEO macroscopic quantum jump corresponding to ordinary state function reduction changes the arrow of time . This would occur to MB as EZ is formed. Second law holds still true but in reverse time direction. MB is the boss and forces time reversal also at the level of ordinary bio-matter. The usual diffusion of molecules to cell occurs but with reverse arrow of time and explains the mysterious removal of impurities observed by Pollack for EZs.

All biological self-assembly processes would use this mechanism. In fact, self-organization quite generally would be dissipation in reverse direction of time: this would explain self-assembly aspect of self-organization. The big quantum jumps would inducing change of the arrow of time would tend to increase of h_{eff} in statistical sense (h_{eff} is identifiable number theoretically essentially as the dimension of extension of rationals and bound to increase in statistical sense). This would correspond to the evolutionary aspect of self-organization [L10, L15]. The increase of h_{eff} requires energy since the energy of state increases with h_{eff} with other parameters kept constant. Energy feed is therefore needed. Dark matter n TGD sense would make itself visible in everyday life.

6 Was Ribosome The First Self-Replicator?

I encountered a link to apopular article (see `http://tinyurl.com/nl2wybc`) describing a highly interesting work [I32] by M. Root-Bernstein and R. Root-Bernstein (daughter and father). The title of the popular article "Forget the selfish gene: Evolution of life is driven by the selfish ribosome, research suggests". As a matter of fact, the article itself is not selling anything of type "selfish X", a dogma which to my opinion is more or less dead: synergy and quantum coherence are much more promising notions relevant to biomatter. "Selfish X" is a paradigm, which suits much better to the description of cancer. The title of the article "The ribosome as a missing link in the evolution of life" would have been much more appropriate also for the popular article.

First a summary of motivations by authors. The basic problem relates to the emergence of life and there are many theories. The models can be divided to "genetics first" and "metabolism first" type models.

1. RNA world is basic example of "genetics first" models. The problem of the "genetics first models" is that it is difficult to understand how prebiotic life could have coped before the complex molecular machinery of metabolism. The second problem of RNA world is that polynucleotides and proteins almost certainly co-evolved. So called compositional replication models start from this assumption but have difficulties in explain replication schemes. Both approaches fail to explain how complex cells emerged from molecular evolution. It is however known that lipid layers of cell membrane are emergent structures not coded by genes (soap films).

2. Second class of models try to proceed from complexity to simplicity by assuming the first replicator (pro-cell typically) but are not able to answer the question "What before this?". The natural assumption is that simple bio-molecules gradually evolved to polymers and polymer aggregates and eventually cell membrane emerged.

According to authors, the challenge is to bridge the gap between self-replicating polymers and fully functional cell by identifying intermediate structures able to replicate, restore and replicate information, capture metabolic components and energy, and transform all these into biochemical networks.

6.1 Trying To Catch The Idea

The basic idea of the authors is simple and brilliant. Ribosome is the transcription machinery transforming DNA to proteins. Also the first replicator must have contained the transcription machinery. Perhaps the first replicator was minimal and contained just this machinery! Perhaps ribosome or its predecessor ("pre-ribosome") indeed was the first self-replicator. One would have beautiful self-reference: ribosome would be the recipe for making a copy about the recipe! Brings in mind Gödel-Escher-Bach!

This assumption is highly non-trivial. In the following I try to sketch for myself what this could mean. In the following I drop "pre"or notational convenience with understanding that ribosome, RNA, amino-acid etc. means "pre-ribosome", "pre-RNA", "pre-amino-acid", "pre-tRNA" etc.. In TGD framework pre-ribosome could be of non-biochemical nature and realized at the level of dark matter.

1. It seems natural to assume that the basic raw material consisted of RNA and amino-acid molecules in the environment. Ribosome could use them to build copies of itself. The question how these were generated will not be considered now.

2. Ribosome consists of rRNA and proteins and uses tRNA to associated to mRNA sequence amino-acid sequence. If ribosome was the first replicator realizing genetic code as mRNA-amino-acid correspondence it had to use its own rRNA as a template for the translation to a corresponding protein.

   If nothing has changed after the emergence of the recent replication mechanisms, the testable prediction is that ribosome amino-acids are images of rRNA sequences under genetic code. One of course expects that the stricture of ribosome has not conserved in precise sense so that this prediction could be too strong.

3. tRNA is a molecule of form RNA-X-amino-acid and rRNA should have contained the genetic information allowing to transcribe and translate the RNA and amino-acid polymers appearing in tRNA.

According to [I32] these predictions are indeed tested in the work considered for Escheria Coli bacterium and it is found that the findings are consistent with the hypothesis.

On basis of these observations one can try to imagine how the ribosome or its predecessor "pre-ribosome" might have replicated.

1. Both the basic units of RNA sequences and corresponding amino-acid polymers of rRNA had to replicate. The most economic assumption is that this occurred simultaneously.

2. One can imagine that rRNA "gene" and the protein coded by it arranged themselves so that they were parallel. The amino-acid coded by rRNA codon acted as a catalyzer for the attachment of a conjugate of rRNA codon to the growing rRNA sequence just as in DNA replication promoter catalyzes the replication. rRNA codon in turm acted as a catalyzer for the addition of new amino-acid to the growing protein. tRNA molecules of form RNA-X-amino-acid from the environment provided the needed RNA codon and amino-acid.

   Remark: I have already earlier considered an RNA world scenario in which amino-acids of tRNA catalyzed the replication of RNA sequences [K24]. When DNA emerged, the roles would have changed and amino-acid sequence was formed instead of the replication of RNA.

   This replication differs from ordinary transcription. In transcription incoming mRNA sequences produce amino-acid sequences as tRNAs attach to the mRNA codons of mRNA attached to the ribosome. tRNA looses its amino-acid but keeps RNA. Now tRNA loses both amino-acid and RNA codon and only the unit X in tRNA? RNA-X-amino-acid remains.

   At some step of evolution the replication of rRNA would have ceased to occur and tRNA would have kept its RNA in the double translation process. Is this possibly biologically?

3. Concerning tRNA there are many possibilities. One can imagine that ribosome and Xs could have served as co-replicators. The reaction $X \rightarrow RNA - X - amino - acid$ and its inverse could have occurred spontaneously. The resulting complex would have attached to

the end of RNA-amino-acid sequence associated with some portion of mRNA just as it does in ordinary translation. In the replication or ribosome RNA-X-amino-acid would have attached to ribosome and X: s would have been produced in the replication of X forming a part of ribosome. In the environment the attachment of RNA and corresponding amino-acid to X would have taken place.

A possible objection is based on ontogenesis-recapitulates-phylogeny vision (ORP). The replicating pre-ribosomes should be still there but they are not. There should be some very simple mechanism preventing the replication but still one can ask whether the ribosomal replication could not occur in special circumstances.

6.2 How The Pre-Ribosome As First Replicator Relates To TGD Approach?

TGD framework predicts that replication as a splitting of 3-surfaces to two copies is a fundamental mechanism of quantum TGD analogous to the $1 \to 2$ decay of elementary particle and the replication of DNA, cells, etc... should reduce to a hierarchy of replications starting from long length scales and proceeding as replications at shorter length scales with master slave relationship between the subsequent levels of the scale hierarchy.

This identification of replication as a mere splitting of 3-surfaces saying nothing about what happens for the quantum states associated with them is too general to allow to talk about unique primary replicator. If one however restricts the consideration to systems consisting of RNA and amino-acid sequences the idea about ribosome as primary replicator becomes highly non-trivial.

In TGD framework it is possible that pre-biopolymers were not bio-polymers but their dark counterparts formed from dark protons sequences at magnetic flux tubes with states of dark proton in 1-1 corresponds with DNA, RNA, amino-acids and tRNA. If so pre-ribosome was realized at the level of dark matter as dark ribosome - a complex formed by dark analogs of bio-polymers.

If so, then pre-ribosome consisting of dark matter at flux quanta could be the primary replicator and the formation of its bio-molecular counterpart would be induced from that of dark pre-ribosome like the dynamics of slave in master slave hierarchy.

This raises questions. How does this replication proceed? Does ribosome still replicate as all other biological structures do and induce replication of low ever level structures in the dark matter hierarchy? Does the ordinary biomatter induced at the lowest level of hierarchy would only make visible this replication?

In the following I briefly summarize the basic TGD based notions involved in attempt to answer these questions.

6.2.1 4-D self-organization and magnetic body

One class of questions concerns the roles of self-organization and genetices. Even the definition of the notion of self-organization is poorly defined. In TGD zero energy ontology (ZEO) forms the basic framework of both quantum TGD proper and its applications to consciousness and biology. In zero energy ontology (ZEO) self-organization is replaced with self-organization by quantum jump sequence leading to the emergence of not only 3-D spatial patters but also of 4-D behavioral patterns: one can say that living system is 4-dimensional and also its geometric past changes in quantum jumps (Libet's findings).

1. Various motor actions of magnetic body appear as basic processes of the quantum self-organization. This includes braiding and knotting, h_{eff} changing phase transitions changing the lengths fo flux tubes, reconnections allowing to build connections between different system consisting of flux tube pairs, and also replication. Also signalling by dark photons is an essential part of the picture and the general hypothesis is that dark photons have same universal energy spectrum as bio-photons and thus in the energy range of molecular transition energies.

2. Replication in TGD framework occurs at the fundamental level as a replications of 3-surface and is completely analogous to $1 \to 2$ decay for point elementary particle. This replication could take place for the magnetic flux quanta representing various biopolymers and higher

level structures and induced the replication at the level of visible matter. As noticed, this replication is not enough in biology and must be accompanied by the replication of the quantum states associated with 3-surfaces.

3. One key question is how the bio-molecular processes arranged into a functional network. Here the hypothesis that magnetic flux tubes form a 3-D grid analogous to coordinate grid with points of grid at intersections of 3 flux tubes and flux tubes as coordinate lines is very attractive. This Indra's web would be behind the gel like structure of cellular water and make it single coherent unit. Behavioral modes would be time evolutions of this grid: motor actions of the magnetic body - or hierarchy of them.

6.2.2 Does dark matter induced the dynamics of visible biomatter?

The idea that dark matter induces the dynamics of biomatter is extremely attractive since the enormous complexity of biochemistry would be only adaptation to the dynamics of the much simple almost topological dynamics of the master represented as flux tubes carrying dark matter.

1. In TGD framework there are good reasons to believe that water contained the prebiotic life forms as dark analogs of various biomolecules consisting of dark proton sequences at magnetic flux tubes with the states of dark proton in 1-1 correspondence with various bio-polymers (DNA, RNA, amino-acids, tRNA). These string like objects would be dark nuclei but with a large value of Planck $h_{eff} = n \times h$ constant and with same size scale as biopolymers. The proposal is that they are present also in living matter and that is interaction between various levels based on dark photons which give bio-photons as decay products.

2. All the basic processes such as transcription, translation, and replication would be realized already at this level. The analogs of these processes assigning to dark analogs of biopolymers the biopolymers themselves would have evolved later. (ORP) suggests that ordinary biopolymers are accompanied by parallel flux tubes carrying dark protons sequences representing them. Ordinary manner would condense around dark matter.

   The strongest assumption is that dark processes induce their bio-chemical counterparts as biomolecules attach to the magnetic flux tubes for which they form images at the level of visible matter. This might explain why strong dehydration leads to denaturation of biomolecules and why denatured biomolecules are not biologically active. Dark DNA would represent the "soul" of DNA not present in denatured DNA! Same of course would apply to other biopolymers: the loss of dark matter would induce the in vivo $\rightarrow$ in vitro transformation.

   I have proposed the identification of dark counterparts of RNAs and amino-acids as complex braided and knotted structures with braiding carrying information making possible topological quantum computation like processes and topological realization of memory. DNA would provide a symbolic representation coding also the braiding characteristics of the dark amino-acid sequence. Dark amino-acid sequence would represent the braiding physically ad dark DNA as a sequence of symbols.

   Cyclotron frequencies are crucial for communication and the strength of magnetic field on flux tubes emanating transversally from dark amino-acid sequence would be determined by the state of dark proton. The correspondence between dark RNA and amino-acid would be determined by the condition that cyclotron frequencies are identical for the corresponding dark proton states (DNA and mRNA, RNA and amino-acid) so that resonant interaction is possible.

3. This picture conforms with the chemical properties of DNA, RNA and proteins.

   (a) RNA does not appear as double strands and in unfolded form is much less stable than DNA. This conforms with the fact that DNA serves as an information storage providing symbolic representation of RNA and amino-acids including their folding or at least braiding. RNA in turn would provide the concrete representation for braiding and folding.

(b) DNA double strand is stable against hydrolysis but only inside cell - this could be due to the fact that the phase of water is ordered and ice-like so that it cannot induce hydrolysis by providing water molecules - perhaps the fourth phase of water discovered by Pollack and leading to the formation of dark proton sequences in TGD framework is in question.

(c) The braiding structure of DNA is repetitive and carries no information. This conforms with the idea that DNA and its dark variant provide a purely symbolic representations in terms of genetic code for the corresponding amino-acid- and RNA polymers including also their braiding.

4. One can invent objections against the hypothesis that the dynamics of biopolymers is induced from that for their dark variants.

   (a) RNA is not stable against hydrolysis but it can gain stability by folding. Thus the shape of RNA molecule would not be determined by its dark variant in conflict with induction hypothesis. One can however consider the much weaker possibility that dark sector determines only topological dynamics. Only the braiding of the fold RNA molecules would determined by the braiding of dark variant.

   (b) DNA double strand is stable and braided in repetitive and very simple manner. If chemistry determines the stability of the DNA double strand then DNA double strand would induce the braiding of dark DNA strand rather than vice versa. Now one can argue that if dark DNA appears as double strand this forces the repetitive braiding.

To how high level can one continue this parallelism. For instance, does it make sense to talk about dark variants of cell and cell membrane? Can one tell whether it was pro-cell or bio-molecules that emerged first? It seems that all these structures could have emerged simultaneously. What emerged was dark matter and its emergence involved the emergence of all the others. Hens and eggs emerged simultaneously.

1. Here the findings of Pollack about the generation of exclusion zones, which are negatively charged regions of water obeying exotic stoichiometry $H_{1.5}O$, are suggestive. The TGD based model assumes that a phase transition generating dark protons sequences at flux tubes of magnetic body outside the EZ takes place. The self-organization at the level of ordinary matter would generate dark matter at quantum criticality - a basic aspect of self-organization process leading to higher hierarchy levels taking the role of master. Dark matter would be the master or rather - there would be entire hierarchy of masters labelled by the values of h_{eff}. I have also considered the possibility that the generation of large h_{eff} phases happens at criticality quite universally so that life would be universal phenomenon rather than random thermodynamical fluctuation.

2. EZs with sizes about 200 microns (size of cell) could have been the prebiotic cells. There is also evidence that EZs consist of structures with size of order micron called coherent regions (CDs to be not confused with Causal Diamonds!). Could they have been the predecessors of the cell nuclei inside which dark DNA would be stable? The TGD model for the formation of EZs assumes that they are formed from CDs under irradiation.

   This picture leads also to a view about metabolism predict that UV radiation with energies about 12.6 eV must play a key role in metabolism. The proposal is that this radiation arrives as dark photons along magnetic flux tubes of the magnetic body and excites water molecules inside CDs so that they are energetically at distance of about.5 eV from the splitting of OH bond. The excitation of water molecules inside CDs by metabolic energy quantum of nominal value.5 eV transforms this phase to EZs of Pollack.

6.2.3 Emergence of life as emergence of dark matter?

Many basic questions of biology seem to be hen-egg questions such as "genetics or metabolism?", "cell membrane or biomolecules?", "DNA or RNA?", "RNA or amino-acids?", etc.. This suggests that there exists a deeper level and emergence at this level induced the emergence at the level of biochemistry and cell biology.

In TGD the emergence of living systems would reduce to the emergence of dark matter as large h_{eff} phases of ordinary matter taking place at quantum critical and perhaps even critical systems [K20].

1. The question whether genetics or metabolism emerged first ceases to be relevant in this framework, where basic physics provides candidates for the fundamental mechanisms of metabolism (for instance liberation of zero point kinetic energy when the p-adic length scale of space-time sheet (magnetic flux tube) increases).

   Also genetic code would have been realized already before biochemistry if dark proton sequences provided the counterparts for the fundamental biomolecules. The dark biology as dark nuclear physics would make itself visible via biochemistry induced by it. We would see directly the dynamics of dark matter just by looking living systems!

2. If one takes this picture seriously, then also pre-RNA and various other pre-biopolymers could have been realized in terms dark proton sequences associated with dark magnetic flux tubes. The dark replication process could have been the arrangement of RNA and amino-acid flux tube portions in parallel and replication of the dark proton sequences with the help of the analog of tRNA attaching to the corresponding amino-acid. In this framework the notion of dark ribosome makes sense. It would however replicate only in cell replication.

3. In the biochemical scenarios also the emergence of DNA looks like mystery. In TGD framework dark DNA could have emerged at the same time as dark RNA and dark amino-acids as CDs and EZs emerged and make the stable presence of also ordinary DNA inside CDs and EZs. All basic biomolecules and prebiotic cell and metabolism would have accompanied the emergence of CDs and EZs under the irradiation of water feeding metabolic energy and giving rise to prebiotic photosynthesis (note that the negative net charge of DNAs could be due to the fact that part of protons is at dark flux tubes). Dark DNA could be interpreted as an information storage representing the braiding patterns of dark RNA and dark amino-acids symbolically.

4. In this framework the basic step of the replication is the generation of flux tube parallel to the flux tube from which one forms copy or map (say in DNA replicationandtranscription). How this happens?

   A possible answer to the question relies on the earlier proposal that living system involves kind of coordinate grid formed from magnetic flux tubes serving as coordinate lines and meeting each other at the points of the grid . [K16]. The replication process would involved translation of nearby flux parallel flux tube of the grid near to a given flux tube assignable to say DNA strand as a first step - maybe by h_{eff} reducing phase transition for flux tubes orthogonal the flux tube. After this the building bricks of the new biomolecule would be brought along either of the remaining locally orthogonal flux tubes - perhaps by h_{eff} reducing phase transition. The basic structure would be this Indras web containing visible matter at its nodes with dynamics consisting of magnetic motor actions.

This vision involves of course considerable challenges. One should model the dark ribosome counterparts of the replication process for dark DNA, transcription of dark DNA to dark mRNA, translation of dark mRNA to dark amino-acids, and also possible self-replication of dark ribosome.

7 Potential "missing link" in chemistry that led to life on Earth discovered

In the attempts to understand pre-biology the basic challenge is to understand how the needed short RNA, DNA, and amino-acid sequences managed to form. Phosphorylation (see `http://tinyurl.com/y732fsd3`) is known to be crucial for this process and means energization in standard bio-chemistry. Organic phosphate (see `http://tinyurl.com/cx9ukv9`) possesses somewhat mysterious high energy phosphate bond, which stores energy and makes possible metabolism: in metabolic ATP with three phosphates transforms to ADP with two phosphates by giving one

phosphate with high energy phosphate bond to the acceptor molecule, which is therefore phosphorylated.

In the recent biology phosphorylation of various biomolecules such as DNA, RNA, amino-acid sequences is catalyzed by proteins known as enzymes known as phosphorylases. Kinase is one particular enzyme transferring phosphate from ATP to the acceptor molecule. Proteins consist of amino-acids and would not be present in RNA world, which serves almost as a standard model for the prebiotic period. Ribozymes are catalysts formed from RNA but they catalyze typically only the reversal of phosphorylation.

7.1 The problem and its possible solution

The phosphorylation of short nucleotide sequences and amino-acid sequences, and also lipids making possible formation of small cell membrane like structures is necessary for the formation of larger structures from their building bricks. As noticed, ribozymes catalyze only dephosphorylation. How RNA was phosphorylated during RNA era or were the amino-acid present all the time?

The popular article with the title "*Potential 'missing link' in chemistry that led to life on Earth discovered*" (see `http://tinyurl.com/y9s56xnx`) tells about a mechanism allowing phosphorylation during RNA era in absence of enzymes. The discovery [I18] (see `http://tinyurl.com/y9kvgl24`) is that an organic molecule known as diamidophosphate (DAP) (see `http://tinyurl.com/y88vecs2`) having chemical formula $PO_2(NH_2)_2^{-1}$ could do the job in presence of water and imidazol. Imidazol (see `http://tinyurl.com/y8vgfr42`) has chemical formula$C_3N_2H_4$ and is a molecule possessing aromatic hetero-cycle consisting of 3 C atoms and 2 N atoms.

Remark: Pyrimidine (see `http://tinyurl.com/k3vxl9b`) in turn is aromatic hetero-6-cycle consisting of 4 C atoms and 2 N atoms and having formula $C_4N_2H_4$. DNA (see `http://tinyurl.com/cpndtse`) has as basic building bricks phosphates PO_4^- having valence bonds with deoxyribose (see `http://tinyurl.com/qxv9kg8`) molecules (containing 5-rings with 4 C atoms and one O). Each sugar has valence bond with N of nucleoside C, T, A or G. C and T are pyrimidines with single aromatic 6-ring and A and G are purines obtained by fusing imidazol 5-ring and pyrimidine 6-ring to obtain purine double ring. By replacing one OH of de-oxyribose of DNA with H one obtains RNA.

DAP could solve several problems simultaneously: how the short sequences of RNA (later DNA) and amino-acids were formed, and how the predecessors of cell membranes emerged. It is not however clear to me whether this process could have been fast enough or whether the slowness only made the first step painful.

7.2 How could the discovery relate to TGD inspired quantum biology?

It is interesting to interpret the discovery in TGD framework. The basic question is whether the presence of dark atoms and electrons in bio-molecule distinguish between atomic physics, in-organic chemistry, and organic chemistry. Usually organic chemistry is defined to be chemistry of carbon compounds, typically hydrocarbons. Could it be that the formation of hydrocarbons involves dark variants of proton and electron identified as $h_{eff} = n \times h$ variants of ordinary proton and electron?

7.2.1 From atomic physics to chemistry

How could one proceed from atomic physics to atomic physics to chemistry in TGD framework. The basic question is how to understand valence bond: it is not at all clear whether mere Schrödinger equation allows to understand it. Could the emergence of dark electrons allow their delocalization and formation of valence bonds? It has been known for decades that the heating of rare-earth metals leads to a mysterious loss of some valence electrons and the explanation would be the energy provided by heating kicks them to higher energy states by making some valence electrons dark [L9]. The explanation would be in terms of dark electron orbitals for valence electrons which have radii scaled up by factor n^2 and are analogous to Rydberg states identified as orbitals with large value of principal quantum number and having very large radius.

The dark variants of atoms have binding energy scale reduced by factor $1/n^2$ so that their formation requires energy feed (perhaps radiation at required frequencies). One or more valence electrons of ordinary atom could be dark so that the size of the orbital is scaled up by factor n^2.

The valence bond central for chemistry in general and in particular for basic biopolymers could contain dark electrons delocalized because of larger value of n than for the non-valence electrons. Note that one could be $n = n_0 > 1$ for ordinary atoms making in principle possible atoms with $n < n_0$ with anomalous large binding energy also for the filled shells as the findings of Randel Mills indeed suggest [L6].

Surprisingly, dark electrons would be essential in ordinary chemistry thought to reduce to standard model physics! The increase of n reduces binding energy scale and requires energy feed. This would allow to understand why anabolism (see `http://tinyurl.com/c8x8avz`) - that is generation of biopolymers from their building blocks by generating valence bonds - requires energy feed and why catabolism (see `http://tinyurl.com/cbx99fv`) - the splitting of biopolymers to their building blocks by splitting the valence bonds liberates energy.

The valence bonds would be classified by the value of n and it is quite possible that in organic chemistry the values of n are larger than in in-organic chemistry. Could this mean that valence bonds H and C and N and O have higher values in bio-chemistry? Also the valence bonds between O and H in water could have larger value of n.

To sum up, the transition from atomic physics to ordinary chemistry involved generation of dark electrons associated with valence bonds. The value of n for dark electrons can vary and allow hierarchy of evolutionary steps with increasingly delocalized valence electrons.

7.2.2 From chemistry to bio-chemistry

What about the step leading to a genuine bio-chemistry involving genetic code? Magnetic body (MB) is the basic aspect of biochemistry according to TGD. Pollack effect [L4] (see `http://tinyurl.com/y8uxocch`) leading to the formation of negatively charged regions - exclusion zones (EZs) - would involve generation of dark protons at magnetic flux tubes of MB with electrons left to the EZ - possible as ordinary particles [L4]. Also Pollack effect requires feeding of energy, say as irradiation by photons.

DNA is stable against spontaneous hydration only inside cell membrane. This suggests that the EZs of Pollack containing partially dark water molecules satisfying effectively the stoichiometry $H_{3/2}O$ allowed to stabilize DNA. Therefore EZs are excellent candidates for the predecessors of cell.

The TGD inspired proposal is that DNA strand for which each phosphate has negative unit charge is companied by dark analog of DNA consisting of dark protons such that the states of 3-proton units are in one-one correspondence with DNA, RNA, tRNA and amino-acids and the degeneracies of the vertebrate genetic code (number of codons coding for given amino-acid) come out correctly [L5] (see `http://tinyurl.com/jgfjlbe`). A more general picture is that ordinary chemistry is kind of shadow for the dynamics of dark matter at magnetic flux tubes doing its best to emulate it. This would explain also why genetic code has also other variants.

It would be the emergence of dark protons with large enough value of n, which would distinguish between ordinary chemistry and bio-chemistry. Water is basic element of life and hydrogen bonding is responsible for the formation of water clusters - certainly one of the key aspects of bio-chemistry. Hydrogen bonds (see `http://tinyurl.com/bntn28n`) appear between highly electronegative (see `http://tinyurl.com/pbh6r6c`) atoms such as O, N, and F (electronegativity is roughly the tendency to attract electrons). What distinguishes hydrogen bond from valence bond is that it is proton rather than electron, which is delocalized. This suggests that the delocalized proton is dark proton at magnetic flux tube connecting the hydrogen bonded molecules.

7.2.3 The emergence of metabolism

In the proposed framework the first basic aspect of life would be the generation of dark electrons and protons using energy feed and their transfer between molecules and their generation by providing the needed energy.

1. Metabolism (anabolism) would provide the energy needed to transform ordinary atom (that is electron bound to it) to a dark atom with large value of $h_{eff}/h = n$. This requires energy since the binding energy is proportional to $1/n^2$ and reduced in the process. This is quite generally true for all dark variants of quantum states. One can say that the increase of the complexity of the system by increasing n characterizing its "IQ" requires metabolic energy (in

adelic physics [L11, L10] "IQ" has a concrete interpretation as cognitive resources). Therefore the first steps of prebiotic life was the emergence of energy feed mechanism making possible the increase of n.

2. I have considered the possibility that the period of prebiotic life preceding the emergence of chemical storage of energy used dark nucleosynthesis [L7] (see `http://tinyurl.com/y7u5v7j4`) as the source of metabolic energy. The recently discovered life-like properties [I27] in a very simple system consisting of negatively charged plastic balls in the plasma of Ar^+ ions allows to develop rather detailed ideas about this phase of life [L8] (see `http://tinyurl.com/yassnhzb`).

3. A fundamental question is about the step leading to the chemical storage of metabolic energy to valence bonds with non-standard value of n. Solar radiation could have generated both negatively charged EZs identifiable as possible predecessors of cell membrane and valence bonded molecules storing metabolic energy.

7.2.4 About bio-catalysis

Without bio-catalysis biochemical reactions leading to the formation of biopolymers and cell membrane would be quite too slow. Here phosphorylation enters the game.

1. The TGD based model for bio-catalysis relies on the temporary reduction of $h_{eff} = n \times h$ liberating energy kicking the reactants over potential wall. After this step the catalyst - at least in the ideal situation - receives the energy and the atom becomes dark again.

2. Acid catalyst gives a proton and base catalyst gives an electron. Most bio-catalysts are acid catalysts. The TGD based interpretation should rely on the possibility of dark valence electrons and dark protons at flux tubes. Since base catalysts are associated with non-organic chemistry, the identification of the electron given by base catalyst as dark electron looks natural. Acid catalysts would give dark proton.

Bio-catalysts are usually activated by phosphorylation and de-activated by de-phosphorylation but there are exceptions to this rule. This can be understood if the catalyst activates a molecule acting as a switch for a reaction. Catalysts related to phosphorylation are known as phosphotransferasess (see `http://tinyurl.com/y87crqad`) and contain kinases transferring phosphate from ATP to the acceptor molecules.

Phosphatases (see `http://tinyurl.com/ybf9onba`) remove phosphate from the target molecule: they are hydrolases (see `http://tinyurl.com/y88zayj7`) and use water to remove the phosphate and to hydrate the molecule.

7.2.5 The difference between organic and inorganic phosphates

Phosphate appears as too variants: organic and inorganic.

1. Organic phosphates bound to biomolecules have charge -1. Some electrons of organic phosphate ion have transformed to valence electrons and are therefore dark. Also some protons - one dark proton per dark electron to not affect the observed charge in short scales - would be dark and at the magnetic body of the organic phosphate. Both dark protons and dark electrons would be present and give rise to somewhat mysterious high energy phosphate bond.

2. Free phosphate in water environment appears in ionized variants $H_nPO_4^{n-4}$ and is regarded as in-organic and have negative charge 4-n. In inorganic phosphate some dark protons and ordinary electrons giving rise to the negative charge have combined to hydrogen atoms. The larger the number of hydrogens is, the higher the level of inorganicity is.

   The fractions of variants of free phosphate in water depend on pH characterizing the density of protons present. Could pH in fact characterize the fraction of dark protons at magnetic flux tubes? Or could it also characterize the fraction of dark hydrogen atoms present. Similar question applies to the counterparts of pH for other biologically important ions.

7.2.6 About phosphorylation and the interpretation of DAP

At chemical level phosphorylation attaches phosphate ion to the hydroxyl group (R-OH) of the acceptor molecule. At deeper level phosphorylation would give dark electron to the acceptor molecule and dark proton to its MB. Phosphorylation would increase the quantum coherence length: the formation of short RNA, amino-acid sequences and of cell membrane like structures would be a basic example of this.

What about the interpretation of the role of DAP in this framework? DAP has charge -1 as also the phosphate bound to DNA and RNA have (in ATP the outermost phosphate has charge -2). DAP is very similar to the phosphate in DNA and RNA and expected to carry high energy phosphate bond. In TGD framework it would possess both dark valence electrons and dark protons at magnetic flux tubes with only one ordinary electron responsible for the charge of DAP. Due to the properties of phosphatase the phosphorylation would be very simple process at the level of dark electron and proton. Hence DAP and imidazole could make possible the phosphorylation.

7.2.7 About dephosphorylation and phosphoryl transfer

The scanning of web shows that some sources talk of dephosphorylation and some sources about phosphoryl transfer reactions and it remained unclear to me whether the two terms really have the same meaning. In any case, in TGD framework one can distinguish between these notion. Dephosphorylation could mean either phosphoryl transfer (transfer of phosphate between donor and acceptor molecules) or "dropping" of organic phosphate to water environment and giving it negative additional negative charge (the transfer would be now to water environment) and making it inorganic.

1. Phosphoryl would transfer removes PO_4^- group and presumably also the associated dark proton from the target and transfers them to the acceptor molecule and its MB. I have proposed that reconnection of flux tubes transforms the flux tubes entering to the donor molecule to that associated with the acceptor molecule so that dark proton is automatically transferred. In ATP-ADP process the phosphate group and presumably also the dark proton and electron would be transferred to the acceptor molecule from ATP. ADP is dephosphorylated and acceptor phosphorylated.

2. In "dropping" the outcome would be in-organic phosphate denoted by P_i, which is a mixture of HPO_4^{-2} and $H_2PO_4^{-1}$. One interpretation is that 1 or 2 dark protons from magnetic flux tubes have transformed to ordinary protons and combined with electrons to form hydrogen atoms. This operation would reduce the number of dark particle and thus the "evolutionary level" of the system.

Dephosphorylation is known to lead to a decomposition of the donor molecule to smaller structures, indicating the reduction of h_{eff}/h and thus of quantum coherence length. In RNA world dephosphorylation would be catalyzed by ribozymes and in some important cases also in the recent biology. Dephosphorylation would reduce quantum coherence length and lead to the decomposition of structures to smaller ones: mRNA splicing is one example of this. Catabolism of nutrients and the decay process of dead organic matter provide further basic examples.

Catabolism (see `http://tinyurl.com/cbx99fv`) of nutrients and the decay process of dead organic matter suggest what happens. In the first preliminary step of catabolism catalysts are involved. At the second step of catabolism inorganic phosphate is formed, which suggests that the number of dark protons is reduced in the process. This conforms with the reduction of the value of $h_{eff}/h = n$.

8 Life in Venus? What says TGD?

Evidence for life in a rather unexpected place - Venus - has emerged [I19]: see the popular article in Scientic American (`https://cutt.ly/qfD973w`). The atmosphere of Venus shows signs of phosphine PH_3 - the analog of ammonium NH_3 -, which cannot be produced by inorganic processes. There are small amounts of phosphine in the Earth's atmosphere and has an organic origin.

Same might be true in the case of Venus. Perhaps simple bacterial life is in question. Is it in the atmosphere or somewhere deeper in an open question.

One can find from Wikipedia that phosphine has the chemical formula PH_3. In inorganic chemistry it is very difficult to form phosphine from phosphate $(PO_4)^{-3}$ which is central in living matter. Somehow reduction must occur: the double valence bonds O=P of phosphates must in the final situation ordinary valence bonds in PH_3.

TGD predicts that all planets have life in their interior. This would solve the Fermi paradox. Also Earth's life would have evolved in the interior and emerged to the surface in the Cambrian Explosion when a large number of multicellulars emerged as if nowhere. The reason would have been a rather fast increase of Earth radius by factor 2: in TGD cosmology continuous expansion for astrophysical objects is replaced by a sequence of fast expansions followed by steady non-expanding states [L14, L13]. Whether the phosphine could emerge from the interior of Venus is an interesting question.

TGD also predicts a new kind of chemistry involving the notions of magnetic body (MB) carrying dark matter identified as phases of ordinary matter with effective Planck constant $h_{eff} = nh_0$ ($h = 6h_0$), which can have very large values. Also the notions of acid resp. base and reduction and oxidation would involve dark protons resp. Dark valence electrons but in biosystems these notions would become fundamental. For instance, in Pollack effect exclusion zones as regions in which every fourth proton goes to a magnetic flux tube as a dark proton would be formed. For pH = 7 the fraction 10^{-7} of protons would be dark! In biology dark protons, electrons, and also dark ions would be fundamental.

MB would be the "boss" controlling the ordinary biomatter using dark cyclotron photon signals and resonance as a control tool. This new chemistry relying on what I call number theoretical (or adelic) physics would be central for the basic biomolecules such as DNA, RNA, tRNA, and amino acids having dark analogs accompanying them. The phosphates of DNA nucleotides with negative charges would be neutralized by dark protons and dark proton triplets would define a fundamental realization of the genetic code. Also amino-acids would be accompanied by dark proton (actually dark hydrogen) triplets.

Transforming protons to dark protons in Pollack effect requires an energy feed: IR photons do the job best. This means that dark protons carry metabolic energy and in ATP there could be 3 dark protons neutralizing the negative charges of phosphates. Together with dark electrons associated with valence bonds this would explain the questionable notion of high energy phosphate bond. ATP $\rightarrow$ ADP would transform one dark proton to ordinary one and break a valence bond, which for a dark electron has an abnormally high energy. Both of them would give energy.

If there is life in Venus, one might expect that both these new phenomena predicted by TGD are involved. TGD based vision about quantum biology suggests the possibility of sulphuric life in which the replacement $O \rightarrow S$ occurs in the basic bio-molecules- DNA, RNA,tRNA, and amino acids. This would leave cell membrane as such. A less plausible replacement (O,N,P) $\rightarrow$ (S,P,As) shifting life downwards along the Periodic Table is also discussed.

8.1 Could there be sulfuric life in Venus?

One can find an article (`https://cutt.ly/QfGhpoV`) about the chemistry involved with phosphine. Not only there exists no known in-organic manners to produce phosphine in Venusian atmosphere but also the biological pathways for the production of phosphine in the Earth's atmosphere by bacteria are unknown. Note that these bacteria are non-aerobial: I do not know whether S replaces O in their metabolism.

Could the new chemistry predicted by TGD and based on dark protons and dark electrons be involved? Dark protons carry metabolic energy - Pollack effect producing dark protons indeed requires energy feed - and the transformation of one of 3 dark protons in ATP $\rightarrow$ ADP would liberate metabolic energy. Could an analog of this metabolic mechanism help the formation of phosphine?

8.1.1 Basic fact about Venus and Venusian atmosphere

One learns from Wikipedia (`https://cutt.ly/DfGhuid`) basic facts about Venus.

1. Venus is one of the four terestral planes meaning that it has a rocky body like Earth. Surface gravity is .904 g, surface pressure is 91 atm, and surface temperature corresponding to .0740 eV (eV = 10^4 K), which happens to be rather near to cell membrane potential.

   In clouds at heights 50-60 km from Venusian surface, the temperature is between 0 and 50 ^{circ}C. The assumption that these regions contain the PH_3 is theoretically justified if the life in question is similar to that in Earth.

2. Venusian atmosphere 95 per cent CO_2. There is 3.5 per cent N, 150 ppm SO_2, 70 ppm Ar, 20 ppm waer wapr, 17 ppm CO_2, 12 pp, He, 7 ppm Ne, .1-.6 ppm HCl, 0.01 - 0.05 HF.

8.1.2 Some data items about the role of sulfur in terrestrial biology

There is a nice article "Sulfur: Fountainhead of life in the Universe?" by Benton Clark at the page of Nasa [I11] (`https://cutt.ly/qfGsIST`) giving a summary about sulfur and - as the title suggests - implicitly proposing that sulfur based life might have preceded the recent life.

1. Table 1 gives an overview about the cosmochemisty of sulfur. Note that in Sun S/Si ratio is .5.

   Remark: Even Sun has been proposed as a possible seat of life. The general vision about dark matter as a master controlling ordinary matter and dark proton sequences at magnetic flux tubes providing a universal realization of genetic code allows to consider the possibility of life at temperatures much higher than at Earth.

2. The role of sulfur in planetary evolution is discussed. The abundance of S is as high as 15 per cent in the Earth's core. Earth's crust contains 500 ppm of S and volcanic emissions are rich in sulphur. Sea water is rich in sulfate (SO_4) ions. Table 2 two lists various sulfur compounds in volcanic emissions.

3. Sulfur compounds are discussed. Sulfur can have several valence states including oxidation numbers -2,0+2,+4,+6 and sulfur can appear in compounds with several valence numbers. By this transversality sulphur could have an important role in autotrophic metabolism involving only chemical energy sources.

   Remark: The valence of given atom in molecule (`https://cutt.ly/QfGhaCL`) is the number of valence electrons, which the atom has. For instance, the double bond corresponds to 2 units of valence. Atomic valences characterize the topology of the valence bond network assigned with the molecule. Oxidation state, which can be negative, is a more precise measure telling how many valence electrons the atom has gained or lost. In the TGD framework the valence bond network would correspond to a flux tube network.

4. The role of sulfur in biochemistry is central. Sulfur plays major roles in energy transduction, enzyme action, and as a necessary constituent in certain biochemicals. The latter include important vitamins (biotin, thiamine), cofactors (CoA, CoM, glutathione), and hormones. Table 4 given also here summarizes the biological utilization of sulfur compounds.

   - Energy source (sulfate reduction, sulfide oxidation)
   - Photosynthesis (non-O2 -evolving)
   - Amino acids (met, cys):
   - Protein conformation (disulfide bridges)
   - Energy storage (APS, PAPS)
     These are analogous to AMP and ADP. Could one think of generalization of the TGD view for ATP $\rightarrow$ ADP to PAPS $\rightarrow$ APS as a basic metabolic mechanism? It might be that APS and PAPS do not survive in the Venusian atmosphere.
   - Enzyme Prosthetic group, (Fe-S proteins)
   - Unique biochemicals (CoA, CoM, glutathione, biotin, thiamine, thiocyanate, penicillin, vasopressin, insulin).

5. The role of sulfur in the biogeochemical cycle is illustrated in Figure 1. In autotrophic energy metabolism, which does not have organic compounds as sources of energy, sulfur compounds are involved. One can distinguish between sulfur bacteria, sulfate reducers, and sulfur oxidizers. For sulfur bacteria the photosynthesis proceeds - not by splitting H_2O as in the case of green plants and algae - but by splitting H_2S to obtain H atoms: H_2S replaces water. Sulfate (SO_4) reducers liberate energy by increasing the oxidation numbers of S and O ($Na_2SO_4 \rightarrow Na_2S+4H_2O$). Sulfur oxidizers ($H_2S + 2(O2)_2 \rightarrow H_2SO_4$)) reduce the oxidation number of S.

6. SH-group is important for the catalytic function of many enzymes. -S-S link stabilizing systeine is important in establishing the tertiary structure of proteins. Fe-S appear as a prosthetic group (non-peptide group) in enzymes known as iron-sulfur proteins.

7. The presence ecosystems at the mouths of active hydrothermal submarine vents not depending on photosynthesis suggests a chemosynthetic energy source. These communities however require oxidesres and thus photosynthesis in the surface layers. Table 6 lists sulfur based energy sources for biological systems.

8.1.3 The minimal option for a sulphur based life in Venus

Before speculating it is good to summarize the basic facts. Venus has a lot of H_2S - analog of water H_2O in its atmosphere. Also CO_2 is present as also nitrogen N. There is a could layer rich in H_2S and having temperature and pressure very much like at Earth. The environment is extremely acidic and this is a real challenge for terrestrial life forms. There exists however extreme terrestrial extremal acidophiles. They are bacteria.

The idea is to replace O with S in some basic molecules of life and processes to overcome the acidity problem. What are these molecules and processes?

1. Could other biomolecules remain as such and could the cell membrane shield the DNA and proteins inside it against sulphur acid? The outer ends of lipids are hydrophobic: could they be also H_2S-phobic?

2. Could H_2S replace water in some sense in Venusian life? Could water as an environment of the cell be replaced with H_2S?

What could the replacement of the water environment with H_2S mean?

1. Could photosynthesis rely on the splitting of H_2S rather than H_2O? Ordinary photosynthesis takes place inside the cell interior and involves ordinary proteins in enzymes and sugars as products. This would however require the presence of H_2S is in the cell interior. This does not look a plausible option without a profound change of the chemistry inside the cell replacing perhaps O with S in basic biomolecules such as DNA, RNA and proteins? This suggests that the photosynthesis inside Venusian bacterial cells occurs in the usual manner.

2. The TGD based quantum biology also involves the notion of magnetic body (MB) as a controller of the biological body. Could H_2S have the same role in Venusian prebiotic life as H_2O in the terrestrial prebiotic life?

   In the terrestrial life according to the TGD magnetic body (MB) of the water with hydrogen bonds is accompanied by flux tubes appearing with various values of $h_{eff} > h$ for dark protons. This would make water a multiphase system providing water with its very special thermo-dynamical properties at the temperature range 0-100 C.

   The flux tubes carrying dark protons sequences generated in the Pollack effect creating negatively charged exclusion zones (EZs) would realize the dark analog of genetic code: the negatively charged cell is an example of this kind of EZ.

   Water memory and the entire immune system would basically rely on these flux tube structures. DNA would be accompanied by parallel dark analog and the same would be true for RNA, tRNA, and amino acids. Water would be living even before the emergence of the chemical life and MB would control the chemical life.

Could also H_2S allow dark hydrogen bonds and Pollack effect? Could the basic difference with respect to terrestrial life be that cells live in H_2S rather than in H_2O?

The separation of O *resp.* S to proto cell interior *resp.* exterior is required for the most conservative option. This requires a formation of lipid membrane like structures consisting of hydrocarbons isolating the interior from exterior and taking care of the separation. This requires charge separation by Pollack effect and solar radiation could provide this energy. H_2S must be replaced with H_2O in the proto cell interior. As a physicist I can only speculate about the possible chemistry of the process. For sulfur and its chemistry see the Wikipedia article (`https://en.wikipedia.org/wiki/Sulfur`). The following proposal is by a non-professional and very probably not correct as such. The basic challenge is however obvious: generate proto cell membrane and transform H_2S to H_2O inside it by reaction which in the optimal situation do not require catalyst but might require energy feed as solar radiation.

1. How the double lipid layer of the proto cell membrane separating S- and O-worlds could have formed? The formation of hydrocarbons of form C_nH_{2n} appearing as building blocks of lipids had to take place - perhaps only from CO_2 and H_2S. Note that that SO_2 is the third most significant atmospheric gas in Venus and could have been be produced in this process and participate it. SO_2 has been detected also in volcanoes and one can consider the possibility that the mono-cellular life in volcanoes could have evolved by the same mechanism as in Venus clouds.

   Did something like $CO_2 + H_2S \to CH_2 + SO_2$ necessarily accompanied by a polymerization of CH_2 to C_nH_{2n} occur? Also in the proto cell interior hydrocarbons could have formed by this mechanism. The consumption of CO_2 in the proto cell interior would have induced a further flow of CO_2 from the proto cell exterior and generated more SO_2 which could have flown out or been used for other processes.

2. How was the H_2S inside the proto cell membrane replaced with H_2O? Assume that sulphur dioxide SO_2 is generated in the formation of hydrocarbons. Is the reaction $SO_2 + 2H_2S \to 2H_2O + 2S$ favoured by $T\Delta S$ or $SO_2 + 2H_2S \to 2H_2O + S_2$ favoured by ΔE in $\Delta G = \Delta E - T\Delta S$ a plausible option? Note that elemental S is hydrophobic and some bacteria generate pieces of sulfur inside them. One can also consider the possibility that the sulphur in the final state forms S_8 units: the valence bonds in S_8 make the reaction energetically more favored but entropically less favored.

3. What about oxygen? Ordinary photosynthesis could have produced O_2 by the splitting of the water. One can also ask whether the reaction $X + CO_2 \to CS_2 + O_2$ with $X = 2S$ or $X = S_2$ have generated molecular oxygen O_2 in the proto cell interior and whether carbon di-sulfide CS_2 as the analog of CO_2 could have flown outside the proto cell membrane?

4. How to overcome the possible activation energy barriers for various reactions involved? Suppose that solar radiation indeed generates dark protons from H_2S by a generalization of Pollack effect [L4, **?**] by creating fourth phase of H_2S having stoichiometry $H_{1.5}S$ - as Pollack might put it. As the dark protons transform to ordinary protons, they liberate energy and this energy could make possible to overcome the activation energy barrier. This would not be new in TGD framework: in biochemistry according to TGD the energy liberated by ATP$\to$ ADP would transform one of the 3 dark protons of ATP to ordinary proton and liberate energy as metabolic energy quantum to overcome activation energy barrier.

The O-S separation would drive CO_2 from the exterior to interior and bring it back as CS_2 and replace S with O in the interior. Proto cell membrane would emerge before the standard chemical realisation of the genetic code. The usual hen-egg problem "Which came first, cell membrane or genes?" is avoided since the dark variant of the genetic code would be represented using sequences of dark proton triplets representing the analogs of DNA, RNA, tRNA, and amino acids. Also the other two hen-egg problems: "Which came first, metabolism or genetic code?" and "Which came first, metabolism or cell membrane?" would be circumvented. The fact that the lipids of the cell membrane involve phosphates with negative charge suggests that they are accompanied by dark protons and genetic code has a 2-D variant assignable to the lipid lattice as 2-D dark proton lattice and decomposing to 1-D sequences [L12, **?**]. The ordinary chemical genetic code would emerge later than this realisation after the emergence of basic biomolecules in the protocell interior.

8.1.4 More radical options for sulfuric life at Venus

There are also other options based on a radical modification of the chemistry of the ordinary life. They look less realistic from TGD point of view (which has been changing on daily basis during this week!).

1. Venus receives a lot of sunlight but one can ask whether photosynthesis be replaced with chemisynthesis? Chemical energy would be liberated in cycles involving sulfur containing compounds with varying degrees of oxidation of sulphur would liberate chemical energy as metabolic energy. At the bottoms of terrestrial oceans there are lifeforms around volcanoes, which might have this kind of metabolism.

2. **Option I** below: The extreme adicity of the Venusian atmosphere is the basic problem and the data about the composition of Venusian atmosphere suggest that O should be replaced with S in basic bio-molecules and water should be replaced with hydrogen sulfide H_2S (about bacteria producing H_2S see this), which is a gas smelling like rotten egg and produced in the decay of organic matter. Note however that CO_2 dominates in the Venusian atmosphere so that the replacement of O with S can be criticized. Carbon compounds can survive in the cloud to which PH_3 is assigned. The atmosphere contains also N.

   One can ask whether the exterior of the proto cell for the minimal option discussed above could have deloped a life based on the replacedment of O with S.

3. **Option II** below: This option is radical and probably non-realistic but as a mathematician I cannot resist its formal beauty. Could Venusian life be obtained by shifting terrestrial life one row downwards along the right end of the Periodic Table so that basic elements O, N, P of terrestrial life would be replaced with their chemical analogs S, P, As?

   Remark: Phosphine PH_3 reported to smell like rotten fish would be the counterpart of ammonia NH_3 giving pee its aroma and would have a similar role for Option II.

   Si has boiling point .1687 eV to be compared with the surface temperature .0740 eV - note however that also carbon is solid up to very high temperature and also many hydrocarbons are solids physiological temperatures. Arsenic (As) is fused by some bacteria as a metabolite and one might think that the analog of the higher energy phosphate bond obtained by replacement (O,P) $\rightarrow$ (S,As). The basic objection is that the Venusian atmosphere contains a lot of C and in CO_2 and N so that Option I seems to be enough. PH_3 is produced also by the terrestrial bacteria.

Below the radical options I and II are discussed but one must bear in mind that the replacement of H_2O with H_2S in photosynthesis for bacterial life might be enough if lipid layers of cell membrane are also H_2S-phobic.

8.1.5 Comparing the two radical options

It is interesting to look explicitely for the modifications of the basic biomolecules for the proposed options.

1. Consider first amino-acids (`https://cutt.ly/7fGhfsj`). The replacements would be O $\rightarrow$ S for Option I and (O $\rightarrow$ S, N $\rightarrow$ P, P $\rightarrow$ As) for Option II. This would allow a realization of analogs of nucleotides and amino-acids providing representations for their dark analogs realized in terms of dark proton sequences.

   Amino acid has the structure X-(Y-R)-Z, X= NH_2, Y=C-H, Z= O=C-OH. R is the varying amino-acid residue and X,Y,Z define the constant part. The replacements would be

   Option I: Z=O=C-OH $\rightarrow$ S=C-SH

   Option II: X=C=NH_2 $\rightarrow$ PH_2, Y= C-H$\rightarrow$ Si-H. Z= O=C-OH $\rightarrow$ S=Si-SH.

   In the formation of peptide one has replacement X= $\rightarrow$ C-N-H and Z$\rightarrow$ O=C-O-C. This would give replacemens:

   Option I: X= $\rightarrow$ C-N-H and Z$\rightarrow$ S=C-S -C.

Option II: X→Si-P-H and Z→ S=Si-S-Si for Option II.

In the TGD framework amino-acids would be accompanied by dark proteins with sulfuric analogs of amino-acids pairing with dark proton triplets: the dark amino-acid would be same and couple with amino-acids having the residues for with energy resonance coupling is possible.

Cyclotron excitation of dark proton triplet and excitation of R would couple resonantly: the transition of dark photon triplet would generate dark photon triplet transforming to ordinary photon and exciting the R to excited state. This would select the possible residues.

The first guess is that they are obtained by the proposed replacement too. The dark protons coming from NH_2 and one dark proton coming from C-N-H would do so also for the Option I. Amino-acid residues contain as a rule OH and O= and would be replaced with SH and S=. Note that for met and cys are the only amino acids containing S.

For Option II dark protons would come from PH_2 and Si-P-H for option II and would be neutralized by dark electrons to give rise to dark hydrogens.

2. For DNA (`https://cutt.ly/OfGhhWs`) the replacements would be following

   Option I: O → S in sugar 5-ring and in nucleotides

   Option II: (C, O, N) → (Si, S, P) in sugar 5-ring and nucleotides and $PO_4 \rightarrow AsS_4$.

3. Similar replacements would be carried in metabolic energy currencies AXP, X= M,D,T and GXP having also role as storages of metabolic energy. Saccharides like $C_6H_{12}O_6$ as chemical energy storages would have analogs obtained by replacement

   Option I: O → S

   Option II: (C,O,N) → (Si, S, P).

4. In the lipids of cell membrane there would be no changes for Option I and for Option to one would have (C → Si, $PO_4 \rightarrow AsS_4$).

Option I is clearly favored over Option II if the Venusian life resides in clouds at height of 50-60 km, in particular by the possibility of having cell membrane identical that for the terrestrial life. However, in the TGD framework the most plausible option does not involve any changes in the basic biochemistry of life. The only change is the replacement of water with H_2S as the environment of the bacterial cells. Dark protons and dark photons make possible communications between bacterial cells even in the acidic environment.The empirical test is whether the Pollack effect is possible also for H_2S.

9 Multilocal viruses

I learned about very interesting piece of strangeness in biology known already for half a century (see `http://tinyurl.com/yyh5s2c8`): there are viruses, which can split into segments going into different host cells, replicate and produce proteins there, and self-assemble to original virus after this.

9.1 Findings

Virus (see `https://en.wikipedia.org/wiki/Virus`) consist of DNA or RNA, protein coat, and in some cases outside envelope consisting of lipids and analogous to cell membrane. Typically viruses consist of DNA or RNA decomposing to short segments coding for single protein. The reason for this is that RNA replication is prone to errors and for short segments these errors are not so fatal. Also DNA can be segmented but the segments are longer. RNA can be have positive sense in which it can be directly translated to protein or negative sense in which case replication producing positive sense RNA is needed made possible by an enzyme contained by the virus.

The usual thinking about viruses is that virus finds its way to cell and then uses the genetic machinery of the cell to replicate its DNA and RNA and produce also proteins. This does not not occur in the case of multipartite viruses infecting plants. The virus can split into segments

infecting host cells separately. The segments of RNA and proteins contained by the virus are thus shared by different cells are replicated and coded to proteins. The outcome of the process is then brought together in some cell which need not contain gene segments in it and self-assembly to full virus can occur. Also fractured viruses can flourish and can infect some other plant.

It has been found that the full complement of most viral segments is missing from most plant cells. Protein required for viral replication present in cells that did not have genome for producing it so that the produced proteins can be transferred from the cell where they are produced to neighboring cells: it is though that so called plasmodesmata connecting cells to a network make this possible.

In standard view assuming that the viral segments are completely independent systems multi-partitioning has high risks. In this view theoretically not more than 4 segments are possible. For instance, 8 has been observed in the examples discussed. Even flu virus decomposes into 8 DNA segments with the cell inside which it replicates. Multi-partitioning produces also problems for spreading. In the case of FBNSV viruses mentioned in the article on the insect - aphid- eating FBNSV spreads the virus to plants. How can it get all 8 parts of virus simultaneously? This is very difficult to understand if the segments are really independent.

This suggests that the view about these viruses somehow wrong. Multi-partitioning happens and standard view does not allow it.

9.2 TGD based model for multi-local viruses

One can start by asking why the multi-partitioning implying modular reproduction (something analogous to that in industry!)? One good reason is that host cell might not be able to recognize the segments. Also transcription of too large number of RNAs might be too much for the host and kill it. It seems that viruses act as populations.

TGD based model is based on familiar basic notions.

1. The basic mystery of the biology is coherence of organisms. Bio-chemistry alone cannot explain it. In TGD quantum coherence of dark matter identified as $h_{eff} = nh_0$ phases of ordinary matter at magnetic flux tubes of the magnetic body (MB) of the system is quantum coherent in long scales and this quantum coherence forces the coherence of ordinary living matter.

2. The flux tubes of MB connect cells to larger networks (tensor networks). In particular the segments of virus can be connected to a network in this manner. The segments would be effectively free but their behavior would be correlated. Virus would be multi-local entity at the level of ordinary matter but single connected structure at the level of MB.

3. The TGD based model for bio-catalysis and replication and the model for monopole flux tubes suggests that the phase transition increasing $h_{eff}/h_0 = n$ increases the length of the flux tube. This process requires metabolic energy since quite generally the energy of system increases with n serving as a kind of IQ of the system measuring its algebraic complexity and identifiable as the dimension of extension of rationals assignable to the system. Multi-partitioning requires metabolic energy presumably given by a host cell. The components of multi-partitioned virus are virtually independent but flux tube connections are not lost. There are very many possible multi-partitions and the individual host cell can contain several segments.

4. If the decay of virus to multi-partition corresponds to ordinary state function reduction ("big" state function reduction (BSFR) in zero energy ontology (ZEO) the arrow of time changes at the level of MB of virus (dark matter). n increases in statistical sense in BSFR so that the multi-partitioned state should have higher IQ and is thus favored by quantum TGD. One might perhaps say that when virus is not active it does not need too much IQ: IQ requires metabolic energy feed and low IQ is the most economical choice in the dormant space. When virus infects the host it become active and and increase of n makes it multi-local at the level of ordinary matter.

   If this view is correct the self-assembly of the virus would lead back to dormant state with opposite arrow of time. That dormant state of virus would correspond to opposite arrow of

time for "virus self" would conform with the general view that observer with opposite arrow of time than conscious entity experiences it as sleeping. One must be of course however very cautious with interpretations.

5. These dormant states would not be specific to viruses. Also folded protein would be dormant. External perturbation would feed metabolic energy feed waking up the dormant protein and protein would un-fold and become active and intelligent.

   Same applies to multi-locality. Also bacterial colony could be seen as single organism multi-local only at the level of ordinary bio-matter. When bacterial colony suffers starvation the bacteria form a single tightly connected structure also at the level of ordinary bio-matter. In the absence of metabolic energy feed the values of n associated with the flux tubes would be reduced and they would shorten causing the phenomenon.

   For cellular organisms the multi-locality at the level of ordinary bio-matter be realized for cell but the distances of cells would be fixed. Also at the level of DNA, RNA, tRNA and amino-acids multi-locality would be realized but the distances would not be fixed. In bio-catalysis the reactants are brought together and here h_{eff} reducing phase transition would take place providing also the energy needed to overcome the potential wall making the reaction extremely slow otherwise. In TGD based model for replication, transcription, and translation this flexible multi-locality is indeed assumed [L17].

6. How sexual reproduction (see `http://tinyurl.com/kuvswc9`) emerged is one of the mysteries of biology. The formation of tightly bound multi-local states of mono-cellulars would have increased the probability for lateral gene transfer between neighboring cells, and also the replacement of mere replication with a two-step process consisting of replication followed by meiosis and fertilization as its inverse. The reconnection of flux tubes assignable to DNA is a prerequisite of this process in TGD framework so that the formation of states analogous multi-cellulars would have made this process plausible.

It has been found (`http://tinyurl.com/qkzwk5t`, thanks for Nikolina Bendedikovic for a link) that multicellulars have monocellular colonies as predecessors in the sense that the bacteria (mono-cellulars) form temporarily tight structures resembling multicellular embryos. The transition from loose multi-locality to a more tight one suggets itself. When metabolic energy feed is low bacteria form tightly bound non-multilocal structures analogous to multi-cellulars. The flux tubes are shorten and metabolic energy is liberated, and also the need form metabolic energy is lower when flux tubes have lower values of h_{eff}. Multi-cellulars would be permanently in this configuration and their intelligence coded by distribution of h_{eff}:s would be realized differently.

Multi-cellulars would have been formed when these multi-cellular like bacterial colonies became permanent and began to evolve from embryos to more developed forms [L14, L16]. Hitherto I have assumed that multi-cellulars were formed already before the Cambrian explosion assumed to be induced by a relatively rapid phase transition increasing reducing the local cosmological constant by factor 1/2, and increasing the radius of Earth by a factor 2. This transition would have brought multi-cellulars to the surface from underground oceans giving also rise to the ordinary oceans. I have compared underground oceans to a womb of magnetic Mother Gaia. Ontogeny recapitulates phylogeny principle suggests that the life of the multicellular embryo in womb corresponds to the period of multicellular life in underground oceans.

Second possibility is that the multi-cellulars emerged from underground mono-cellulars during this transition or immediately after it. Could the emergence of bacterial colonies to the surface perhaps providing less metabolic energy feed forced them to form tightly bound colonies forcing the evolution of multi-cellulars?

10 Oil Droplets In Water Solution As A Primitive Life Form?

The origin of life is one the most fascinating problems of biology. The classic was carried out almost 60 years ago. In the experiment sparks were shot through primordial atmosphere consisting of methane, ammonia, hydrogen and water and the outcome was many of the amino-acids essential for life. The findings raised the optimism that the key to the understanding of the origins of

life. After Miller's death 2007 scientists re-examined sealed test tubes from the experiment using modern methods found that well over 20 amino-acids - more than the 20 occurring in life - were produced in the experiments.

The Urey-Miller experiments have yielded also another surprise: the black tar consisting mostly of hydrogen cyanide polymer produced in the experiments has turned out to be much more interesting than originally thought and suggests a direction where the candidates for precursors of living cells might be found. In the earlier experiments nitrobenzene droplets doped with oleic anhydride exhibited some signatures of life. The droplets were capable to metabolism using oleic anhydride as "fuel" making it possible for the droplet to move. Droplets sensed each other's presence and reacted to it and also demonstrated rudimentary memory.

In the sequel a model for the oil droplets as primitive life form is developed using as a constraint the TGD inspired quantum model for living matter. The key ingredients are the notions of magnetic body, the assignment of dark matter identified a hierarchy of macroscopic quantum phases to a hierarchy of Planck constants, zero energy ontology, the model for DNA-cell membrane system as topological quantum computer, and Negentropy Maximization Principle combined with the notion of number theoretic entropy. This entropy can be negative for rational and even algebraic entanglement probabilities, which inspires the vision about life as something in the intersection of real and p-adic worlds.

The basic objection against the identification of oil droplets as a primitive life form is that droplets have no genetic code and do not replicate. The TGD inspired model for dark nucleons however predicts that the states of dark nucleon are in one-one correspondence with DNA, RNA, tRNA, and amino-acid molecules and that vertebrate genetic code is naturally realized. The question is whether the realization of the genetic code in terms of dark nucleon strings might provide the system with genetic code and whether the replication could take place at the level of dark nucleon strings rather than droplets. TGD inspired quantum model of biology leads to a model for oil droplets as a primitive life form. In particular, a proposal for how dark genes could couple to chemistry of oil droplets is developed.

10.1 Intelligent Oil Droplets

New Scientist (see `http://tinyurl.com/y8qyxymd`) tells about a new twist related to the Urey-Miller experiment (see `http://tinyurl.com/y83eks2s`). Martin Hanczyc (see `http://tinyurl.com/ybvwbvg3`) and his colleagues of University of Southern Denmark in Odense are doing research with a rather ambitious goal: the discovery of the recipe of life. The highly demanding challenge is to find candidates for the protocell that preceded the recent cell. What makes the task so difficult that it is not even clear what one should be searching for. For instance, what basic characteristics distinguishing living matter from inanimate systems protocell is expected to have before one can speak about primitive life form? And if one accepts the dogmas of standard biology, one encounters also the nasty hen-egg question which came first: metabolism or the genetic machinery.

Hanczyc and his colleagues have been experimenting with simple candidates for primitive life forms: oily nitrobenzene [I6] (see `http://tinyurl.com/678a2a`) droplets doped with oleic anhydride [I8] (see `http://tinyurl.com/y7ua8mwq`) immersed in alkaline (see `http://tinyurl.com/zelgz`) aqueous solution (alkalinity is by definition an ability to reduce acidicity). They have found that these systems have some attributes generally associated with life. The recent experiments replaced oleic anhydrite with the black tar consisting of complex branched and fractal looking hydrogen cyanide (HCN) polymer [I5] (see `http://tinyurl.com/nehrmu4`) produced by Urey-Miller experiments and found that also now the droplets exhibit lifelike behavior: they sense and respond their neighbors and move towards "food" sources.

The earlier experiments using nitrobenzene droplets doped with oleic anhydridge immersed in alkaline solution began immediately to move along straight lines. What happened that the oleic anhydride at the surface of the droplet reacted with the water splitting to two oleic acid molecules [I7] (see `http://tinyurl.com/yf34q92`) by hydration. This dropped the surface tension of the droplet and by a kind of spontaneous symmetry breaking the reaction rate had maximum at some point of the droplet and a "hot spot" was generated drawing oleic anhydride from the interior of the droplet and generating a convective flow. A pH gradient develops along the surface. The oleic acid in turn moved along the droplet surface from the hot spot to the diametrically opposite side of the droplet [I21] (see (`http://tinyurl.com/yc627j5k`). The net effect was a linear motion.

pH gradient is claimed to be essential for the generation of motion but I must admit that I do not quite understand this point. A primitive metabolism liberating energy is obviously in question. By momentum conservation the total momentum for the convective flow and flow of oleic acid was compensated by a center of mass motion of the droplet.

One could claim that this process belongs to the same class of self-organization processes as the generation of convection patterns as one heats liquid from below. Other researchers have however discovered that the oil droplets can also travel along chemical gradients, something known as chemotaxis used by many bacteria to find food and void threats. One oil droplet managed even to (see "solve" (see `http://tinyurl.com/yb7muvg`) a complex maze containing "food" at its other end [I20]. Whether this kind of behavior can be regarded as a mere chemistry is far from obvious to me. To me this a achievement look like a genuinely goal directed intentional behavior.

Hanczyc has also found that when the oil droplets approach each other they change course to avoid collision, or can circle each other-like partners in Viennese waltz! Oil droplets seem to have even memory. By videoing the paths of oil droplets Hanczyc found that the decision to stop or continue was not random but the behavior at any point of orbits was affected by the earlier behavior. This is by the way an elegant experimental manner to show that non-deterministic behavior is not just randomness. The experiments have been also carried using instead of oleic anhydride mineral oil consisting of a mixture of alkanes having as building block polymers from from CH_4 by dropping two hydrogen from each C as also lipids have (methane CH_4 is the simplest alkane). What distinguishes mineral oil molecules from the oleic anhydride molecules are the oxygen atoms in the middle of the reflection symmetric linear molecule. Also now the droplets move although the process takes place with a slower rate.

The basic objections against the identification of the oil droplets as a life form is that they do not replicate and there is no genetic code. One must be however very cautious with this kind of statements. Maybe the primary life forms are not the droplets and the behavior of droplets reflects the control actions of these life forms on droplets. Perhaps also genetic code could be realized at at totally different level. The recent findings of the group of HIV Nobelist Montagnier [I22] (see `http://tinyurl.com/2co7s6j`) indeed suggest a new realization of genetic code in water closely related to water memory and TGD suggests a concrete realization of this code [K5].

10.2 Some Key Ideas Of TGD Inspired Quantum Biology

Before proposing a model for intelligent oil droplets as a primitive life form its good to list some of the basic ideas of TGD inspired quantum biology.,

1. The basic hypothesis is that the dark matter at the magnetic flux tubes of the magnetic body assignable to any physical system serves as an intentional agent controlling the behavior of the ordinary matter [K21]. Dark matter can correspond to just the ordinary particles- at least electrons and protons- in a phase with non-standard large value of Planck constant forming macroscopic quantum phases. Also biologically important ions could form this kind of phases. TGD inspired nuclear physics [K25] allows also the bosonic counterparts of fermionic with same nuclear charge so that every fermionic ion could be accompanied by exotic bosonic ion so that Bose-Einstein condensates could become possible.

2. The model for dark nucleons [K25, K5] as entangled triplets of three quarks leads to the identification of the counterparts DNA, RNA, tRNA, and amino-acids as three-quark states and one can identify also vertebrate genetic code. DNA sequences correspond to dark nucleon sequences - dark nuclei - in this correspondence. The proposal is that dark proton sequences in water form dark nucleons with so large a Planck constant that nucleon size corresponds to size of singe DNA codon. There is indeed evidence that in atto-second time scale (time scale for corresponding causal diamonds) water obeys effective chemical formula $H_{1.5}O$ as far as scattering of electrons and neutrons is considered [**?**, **?**, **?**]. This would suggest that 1/4 of protons are in dark large Planck constant phase in the experimental situation. This proportion is expected to depend on temperature and pressure and should explain the rich spectrum of anomalies of water [**?**] by regarding it as a two phase system [K22]. Perhaps these protons could form dark nucleon sequences realizing genetic code. These sequences could replicate and evolve and could define at least the analog of DNA or RNA. Maybe even DNA-mRNa-amino-acids translation processing could take place. If a translation machinery

transforming exotic DNA to ordinary has developed during evolution, this fundamental realization of genetic machinery might make possible kind of Research & Development making possible to experiment with different genomes. Evolution would not be a random process anymore [K5].

3. The proposal is that the ordered water layers associated with polar molecules dissolved in water are attached to the magnetic body of the molecule induced in water environment and that this magnetic body mimicking ithe original molecule is an essential element of this primitive life [K5]. The self-organization processes of these layers induced by external perturbations could be the predecessor of processes like protein folding and de-folding. The mechanism of water memory could be based on "dropping" of the magnetic bodies of molecules as a result of repeated shaking involved with homeopathic procedure inducing a sequence of catastrophes driving the evolution of these primitive life forms. One can also ask whether these magnetic bodies could define the analog of proteins providing one realization of dark matter genetic code.

4. If dark nucleons have been the predecessors of chemical life forms, one can circumvent the hen-egg question about whether the genetic code or metabolism came first. In zero energy ontology negative energy signals propagating in the direction of geometric past would in turn provide fundamental mechanism of intentional action, metabolism, and memory. If this is the case, evolution would have only led to a refinement of the fundamental mechanisms of life already existing: there would be no need to pull anything out of hat. The mechanisms for chemical storage and utilization of energy are needed and moving oil droplets would provide a primitive realization of these mechanisms.

5. The notion of negentropic entanglement (see **Fig.** `http://tgdtheory.fi/appfigures/cat.jpg` or **Fig. ??** in the appendix of this book) makes sense if one accepts the role of p-adic number fields and the vision about life as something residing in the intersection of real and p-adic worlds [K7]. Entanglement probabilities for negentropic entanglement must be rational or algebraic numbers in the algebraic extension of p-adic numbers involved and there is unique prime for which this entanglement entropy is maximally negative. Negentropic entanglement makes possible new kind of many particle states analogous to bound states but with negative binding energy. The reason is that negentropic entanglement is stable against state function reduction if Negentropy Maximization Principle determines its dynamics also in the case of negentropic entanglement. The proposal is that the mysterious high energy phosphate bond corresponds to negentropic entanglement and carries both metabolic energy and information [K2]. In this framework ATP-ADP cycle has also information theoretic interpretation as a transfer of conscious information.

The model for DNA as topological quantum computer [K23, K29] led among other things to an identification of magnetic flux tubes connecting bio-molecules as a basic building bricks of living matter.

1. Flux tubes are assumed to connect DNA nucleotides to lipids of the nuclear and cell membranes. Flux tubes could begin from =O in the double bonds R=O or from negatively charged oxygens. In the case of DNA R would correspond to the basic unit in phosphate deoxiribose backbone (see `http://tinyurl.com/69okq`) consisting of aromatic 5-cycle and PO_4 containing one =O and one O^- [I4]. The lipid end would contain =O and -OH and the flux tube could end to either of these or possibly -OH ionized to -O^- by a transformation of proton to dark proton.

2. The braiding of flux tubes makes topological quantum computation like processes possible [K23]. The contractions and expansions of flux tubes induced by phase transitions changing the value of Planck constant would be a basic control mechanism allowing to understand how two biomolecules (say DNA and its conjugate) can find each other in the thick soup of organic molecules. The reconnections of the magnetic flux tubes would be second basic control mechanism and ATP $\rightarrow$ADP process (see `http://tinyurl.com/clnu4`) [I1] involving splitting of phosphate group and liberating metabolic energy and its reverse would represent standardized reconnection process and its reversal.

3. The flux tube ends would contain quark and antiquark (u, d and their antiquarks are involved) coding for the four DNA letters A, T, C, G so that also dark quarks and their antiquarks would provide an elementary particle level realization for the codons. Note that topological quantum computation does not necessitate genetic code and therefore also the repeating DNA sequences regarded as junk could be used for topological quantum computations.

10.3 General Ideas About Oil Droplets As A Primitive Life Form

It is interesting to see what one obtains if one takes the dark nucleon realization of genetic code, the mechanism of water memory realized as magnetic bodies attached to the ordered water layers associated with polar molecules, the model for DNA as topological quantum computer, and the ideas about magnetic body with dark matter as fundamental bio-control as basic ingredients of the model of intelligent oil droplets.

1. The formation of hot spot on the oil droplet resembles spontaneous symmetry breaking. The interpretation as a generation of magnetic body of approximately dipolar magnetic field is attractive. The magnetic body would control the droplet. The change of the direction of the motion of the oil droplet would correspond to the change of the orientation of the magnetic body and would thus reduce to a motor action of the magnetic body.

2. The flux tubes of the magnetic body would be most naturally parallel to the direction of the nitrobenzene polymer strands. Oleic anhydride molecules and the hydrogen cyanid polymers would be transferred along the magnetic flux tubes of an approximately dipolar magnetic field entering to the hot spot from interior and the oleic acid molecules could move along the flux tubes continuing along the surface of the droplet to the diametrically opposite point. The migration of birds along magnetic field lines is a direct analogy for this.

3. The dark matter at the magnetic body would give the oil drop its "intelligence". The dark nuclear genome could be realized at the magnetic body and the magnetic bodies might define the replicating life form as in the TGD based model of water memory for which the magnetic bodies represent molecules as far as low frequency electromagnetic fields characterized by cyclotron frequencies are considered. One could see intelligent oil droplets as manifestation of control actions of a life form defined by dark matter at magnetic flux tubes and the first step in the process eventually leading to a complex control and coordination of the behavior of ordinary matter.

4. The ability of droplets to react to the presence of other droplets would be due to the communications between magnetic bodies based on low frequency photons at cyclotron frequencies but having energy above thermal energy if the value of Planck constant is large enough.

At least oleic anhydrite, hydrogen cyanide, and mineral oil can serve as a fuel of oil droplets and this raises the question what might be the common property shared by them. For illustrations of various molecules involved see **Figs.1**, **2**, **3**, **4**, **??**, **5** in the section containing figures. Certainly this property must relate to metabolism and the model for ordinary metabolism suggests that this property is shared also by the high energy phosphate bond.

1. Oleic anhydrite (see `http://tinyurl.com/y7ua8mwq`) is a lipid formed by as a fusion of two oleic acids consisting of a sequence of CH_2 units and the characteristic (C=O)-(O-H) group at its end. The burning of the molecule splits it to two oleic acids by hydration meaning utilizing one water molecule. The formation of oleic acid in turn involves dehydration so that the burning process is analogous to de-polymerization of DNA or amino-acid sequence by hydration.

2. Mineral oil (see `http://tinyurl.com/eoy5x`) is also a lipid and looks like oleic anhydride locally. In the ideal case however the crucial..(C=O)-O-(C=O)-.. portions are lacking. Oxygenation could however produce this kind of defects to the mineral oil molecules so that the mechanism of burning would remain the same.

3. Hydrogen cyanide (see http://tinyurl.com/nv8qt8) HCN involves valence bond of valence 3 between C and N. The polymers are constructed from H-C-N sequences with single valence bond between both C: s and N: s of two subsequent horizontal H-C-N units, which one can think of as being obtained from (H-C)-(H-C)... sequence and ..N-N-N... sequences with each N and C connected by horizontal valence bond. This polymer replaces oleic acid as a "fuel" reacting with water and liberating metabolic energy. These polymers - which would serve as primitive analogs of proteins- would be transferred along the magnetic flux tubes and burned at the hot spot by hydration. HCN has been proposed to have been a primitive precursor of both amino acids and nuclei acids. With motivations coming from the general vision about quantum biology, it will be proposed that also hydrogen cyanide polymers contain in their C-backbone..(C=O)-O-(C=O)-.. portions as local defects due to oxygenation so that the burning would occur via hydration in all three cases.

10.4 What Are The Prerequisites For Metabolism And Topological Quantum Computation Like Processes?

The basic question is whether metabolism interpreted in TGD framework as negentropy transfer and thus requiring the analogs of high energy phosphate bond and ATP-ADP cycle is possible. The high energy phosphate bonds make also possible flux tube structures serving as a prerequisite for topological quantum computation like process. Both oleic anhydride, hydrogen cyanide and mineral oil can serve as a metabolic source and one should identify the common property of them making. This property should be the analog of high energy phosphate bond.

1. High energy phosphate bond carries metabolic energy. This bond is poorly understood and I have proposed that high energy phosphate bond carries negentropic entanglement which identified in TGD framework as the basic characteristic of life [K7]. In the middle of oleic anhydride there (C=O)-O-(C=O) structure and its splitting in hydration liberates energy. This suggests that this structure also now carries the negentropic entanglement and the metabolic energy. The splitting process of oleic anhydrite occurring at the hotspot would be analogous to ATP→ADP process involving splitting of PO_4 molecule from ATP.

2. Oleic acid is a lipid containing at its second end the characteristic (C=O)-OH group assumed to serve as a terminal for the magnetic flux tubes in the model of DNA-cell membrane system as quantum computer. In the presence energy feed one could imagine that the inverse process transforming oleic acid to oleic anhydride takes place and a primitive version of the metabolic cycle involving photosynthesis and cellular breathing can be imagined. Metabolic and quantum information processing would be very intimately related. By DNA as topological quantum computer analogy the magnetic flux tubes connecting oleic anhydride molecules would make be responsible for primitive topological quantum computation if present in the system.

3. Also when the tar from Urey-Miller experiment replaces oleic anhydrite small amount of oleic anhydride was used to build a film around oil droplet to lower surface tension. This suggests that the oleic anhydride has a deeper purpose and defines the analog of cell membrane and make possible for the magnetic flux tubes from the interior of the droplet to attach to the lipids? This could occur at least in the hot spot and at point opposite to it so that magnetic flux tubes would connect the diametrically opposite points of the droplet Oleic anhydride would therefore serve a dual purpose serving both as a metabolic resource and a building brick of the protocell membrane: metabolic energy would be accompanied by information. Also in real life lipids -about which fats are a special case- have this double role.

4. The process occurs also both for hydrogen cyanide and mineral oilandthis raises obvious objections since the energy and information carrying (C=O)-O-(C=O) structures making also possible the flux tube connects are not present in the ideal situation. One must however remember that the situation in real life is far from ideal and the most obvious idea is that the polymers as such are not enough: oxygen is the basic metabolic resource and oxygenation serving as the loading of metabolic batteries might be the crucial element.

(a) The backbone of both oleic acid (see http://tinyurl.com/yf34q92), oleic anhydride, and of mineral oil polymers (see http://tinyurl.com/eoy5x) is CH_2 sequence common to all lipids. If some fraction of mineral oil polymers contain (C=O)-O -(C=O): s serving as carriers of metabolic energy and information the situation reduces to that for oleic anhydride apart from effects caused by the fact that the density of metabolic energy per volume is expected to be lower, which would explain why the motion is slower.

(b) Also in the case of hydrogen cyanide (see http://tinyurl.com/nv8qt8) polymers one can imagine the presence of similar defect structures due to oxygenation. A portion of...(H-C)-(H-C)-(H-C).... sequence would be replaced with....(H-C)-(C=O)-O-(C=O)-(H-C)... with three carbons lacking. The nitrogen sequence...N-N-N-N-N.. would split to...N-OH and OH-N... so that three nitrogens would be lacking. The total number of hydrogens would remain the same.

Under these assumptions the model explains all three cases using hydration as the basic mechanism of metabolism as well as the conditions required by DNA as topological quantum computer model. Note that the process consumes oxygen just as the ordinary breathing.

10.5 What About Genetic Code And Counterpart Of DNA?

Consider next the possible realization of the genetic code. The first thing to notice is that even in the case that genetic code is not realized the braiding would make possible topological quantum computation like processes and a realization of memory in terms of braiding patterns. Furthermore, chemical realization of the genetric code is not possible so that dark nucleons remain the only possibility in TGD framework. The challenge is to try imagine whether DNA like structures having flux tube connections with the counterparts of lipids in the cell membrane could exist. The following suggestion is a product of free imagination based on analogies and reflects my amateurish skills in biochemistry.

1. Aromatic rings (see http://tinyurl.com/ycf3kv24) [I2] are an essential element of both phosphate deoxiribose backbone of DNA and of DNA letters itself. Nitrobenzene molecule obeys chemical formula (C_6H-5)-NO_2 and contains benzene ring to which NO_2 nitro group is attached. The oily character is due to the benzene ring. Benzene rings could serve as a counterpart for the hydrocarbon 5-cycles appearing in phosphate deoxiribose backbone. Note however that in deoxiribose ring one carbon is replaced with O and two hydrogens with OH. Moreover, single benzene molecule would correspond to the counterpart of DNA triplet rather than single nucleoside. One could however argue that only a backbone is in question so that the differences might not matter.

2. One would naively expect that both nitrogen and phosphorus have same valence equal to three. In PO_4 phosporus has 5 valence bonds as a rule and the interpretation is that phosphorus tends to donate its valence electrons to get empty shell. This kind of states are known as oxidation states and are possible also for nitrogen: hydroxylamine NO_2H is one example of this kind of state. In fact, from the from structural formula of nitrobenzene (see **Fig. 1**) one finds that nitrogen gives one electron to second oxygen so that also this state can be regarded as an oxidation state. This inspires the idea that nitrogen takes the role of phosphorus at least partially.

3. If one does not allow oxidation states, the simplest manner to construct the analog of phosphate deoxiribose backbone is as structure ...X-X-X..., with X= R-O- (R_1-N)-O, where R denotes oleic anhydride and R_1 is for benzene residue. The bridges connecting benzene rings would be reflection symmetric. The breaking of reflection symmetry is however essential since it determines the reading direction of DNA.

4. If one accepts oxidation states, the simplest option is that in benzene-NO_2 complex NO_2 is replaced with (N=0)-O and the counterpart of phosphate deoxiribose backbone would have the structure ...X-X-X—, X=R- (R_1-N=0)-O with R denoting oleic anhydride and R_1 benzene. Oleic anhydride has valence bond to N so that N has 5 valence bonds as phosphorus in phosphate. Also the crucial =O is present. The units connecting subsequent benzene rings

are not reflection symmetric anymore as indeed required. There is however no charged oxygen as in the case of ordinary DNA. Note that the analogs for AMP, ADP, ATP make sense since one can single replace P by N phosphate PO_4.

5. An interesting question is whether the nitrogen based metabolism could be realized as a primordial metabolism. Nitroglycerin (see `http://tinyurl.com/y9a23qen`) is analogous to tri-phosphate although the nitrates are not arrranged linearly as in ATP and is used as both heart medicine and as an active incredient of explosives. The latter use conforms with the idea about the presence of high energy nitrate bond in NO_4.

6. The two mirror image branches of oleic anhydride molecule consist of 15 carbon atoms and the structure is rather long as compared to the basic unit of phosphate deoxiribose backbone so that the distance between subsequent benzene units would be rather long- of order 10 Angstroms. On the other hand, 10 DNA codons correspond to 10 nm length in a good accuracy so that one codon would take 1 nm length also in this case. If double strand is formed, twisting is possible so that the scales could be the same. The size scale of the dark nucleon representing single DNA codon should correspond to the size scale of single oleic anhydride molecule and the required value of Planck constant would be of order 10^6 as the ratio of this scale and nucleon size of order 10^{-15} meters.

7. The counterparts of DNA nucleotides forming a linear structure should join to the benzene rings. Dark nucleon sequences remain the only possibility if one wants a realization of genetic code. Each dark codon represented by dark nucleon would be connected by three flux tubes with quark and antiquark at their ends to single unit of the proposed structure. There would be three =O: s per single benzene ring. Since single benzene ring corresponds to single DNA codon three =O: s are indeed expected. Therefore =O: s could indeed correspond to terminals for flux tubes coming from single dark nucleon representing single DNA codon.

8. The division of oil droplet would be the analog of cell replication and would involve at the deeper level the replication of dark nucleon sequences. This requires the analog of DNA double strand and the analogs of DNA codons would be dark nucleons. Genetic codons could be realized in terms of flux tubes connecting dark nucleon sequences to the oleic acids or oleic anhydrides at the surface of the droplet. It remains to be seen whether the division can be achieve in real world.

To sum up, the proposed model is rather direct application of TGD based vision about life and the killer test is whether the mineral oil oil molecules and hydrogen cyanide molecules are not ideal but actually contain the (C=O)-O-(C= O) pieces carrying energy and information and serve as terminals for the magnetic flux tubes.

10.6 Another Approach To Protocell

Also the group led by Jack. W. Szostak (see `http://tinyurl.com/y8avsbzd`), who was the 2009 Nobel Prize winner in physiology - has carried out beautiful experiments in which they are able to create a candidate for protocell satisfying many of the basic requirements [I25].

One such condition is the ability of protocell to transfer various nutrient molecules through the protocell membrane. In modern cell pumps and channels consisting of proteins are believed to serve that purpose (for a different view see the remark below). Genetically coded proteins were however absent during the primordial era. Therefore the membrane is constructed of branching lipids believed to exists during prebiotic era allowing sugars which are basic building bricks of DNA to permeate to the protocell. Given the DNA template, the basic building bricks of DNA molecule assemble to a copy of DNA in this protocell.

What is still lacking is the generation of the template strand of DNA itself and also the replication of protocell. If dark DNA in the form of dark nucleon strings is really there, the template could result as the assembly of the basic bricks of DNA around it and above a proposal for the analog of this kind of process is suggested. The replication of the dark genes would have been also present from the beginning and would have preceded the replication of genes and protocell. Biological evolution could be seen as a migration from dark space-time sheets to ordinary ones and somewhat analogous to the migration of life from sea to land.

Remark: There are puzzling experimental findings about quantal currents through cell membrane even in absence of metabolic sources. In many-sheeted space-time [K11] one could interpret these currents as various kinds of Josephson currents running between cell interior and exterior along current carrying space-time shees. Pumps and channels would be more like a diagnostic tool allowing cell to measure the concentrations of various important biomolecules and ions.

At first sight the approaches of Szostak and Martin Hanczyc look very different. These approaches have however a lot of common at deeper level if one accepts TGD based view as DNA-cell membrane system or its more primitive version as a topological quantum computer like system relying on the braiding of magnetic flux tubes connecting the counterpart of DNA nucleotides to the lipids of protocell membrane and on the prebiotic realization of genetic code at the level of dark nuclear physics.

One could also argue that the protocell of Hanczyk represents oil based life as opposed to life as we know it. In TGD framework this is a mis-interpretation. The protocells of Hanczyk live in an aqueous environment. Nitrobenzene oil is an aromatic compound as also sugars and contains nitrogen taking in the proposed scenario same role as phosphorus in ordinary life. Oleic anhydride is lipid and- would provide basic building brick for a particular variant of DNA like structure halfway between dark and completely chemical realization. Oleic anhydride would provide also the building bricks of protocell membrane and serve as a nutrient just like fat molecules- also lipids- serve in "real life".

11 Figures

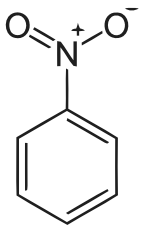

Figure 1: Nitrobenzene

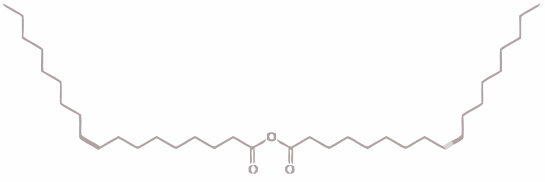

Figure 2: Oleic anhydride

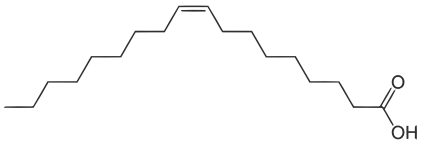

Figure 3: Oleic acid

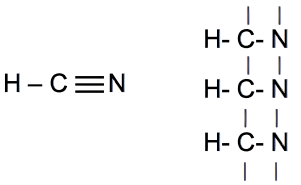

Figure 4: Hydrogen cyanide and hydrogen cyanide polymer.

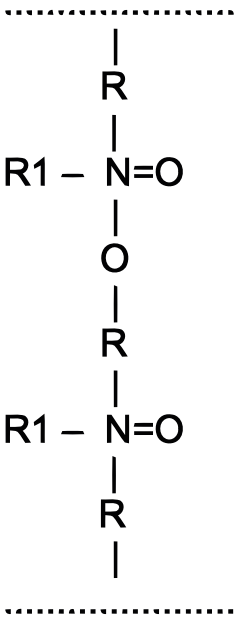

Figure 5: The analog of the deoxiribose phosphate backbone. R denotes oleic anhydride containing two =O: s and R1 benzene ring.

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