# Dark matter, Quantum Gravity and Prebiotic Evolution

M. Pitkänen,

November 20, 2017

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

## Contents

**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.

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. 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 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.

In this chapter 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.

# 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 [K23].

2. EEG and its predicted fractal variants have interpretation in terms of communication from biological body to 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 [K15, 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 [K11].

5. Taking seriously the findings related to water memory and homeopathy [I6, I7, I4, I11, I12] as well as the findings of Gariaev et al [I9, I17] 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 [L10] 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 [K23], [L10].

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!

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.

The appendix of the book gives a summary about basic concepts of TGD with illustrations. There are concept maps about topics related to the contents of the chapter prepared using CMAP realized as html files. Links to all CMAP files can be found at `http://tgdtheory.fi/cmaphtml.html` [L3]. Pdf representation of same files serving as a kind of glossary can be found at `http://tgdtheory.fi/tgdglossary.pdf` [L4]. The topics relevant to this chapter are given by the following list.

- Biophotons [L2]
- Differences between TGD and string models [L5]
- Quantum biology [L11]
- Quantum model of EEG [L13]
- Zero Energy Ontology (ZEO) [L15]
- Bio-catalysis from primitive immune system [L1]
- Gravitational anomalies [L7]
- Origin of genetic code [L9]
- Quantum gravity and biology [L12]
- Water memory and homeopathy [L14]

# 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 [K26, K25] 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 Of Tajmar Et Al For The Anomaly Of 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 $\omega_R$ 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 $\omega$ 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 $\omega$ 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 superconducting 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 their 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 $\rho_m$ and $\rho_m - \rho_m^*$ respectively.

3. Graviphoton mass is same for both ordinary and super-conducting matter and corresponds to the net density $\rho_m$ 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

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

is satisfied for the superconducting ring, one obtains

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

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

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

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 $\epsilon$ might be determined by this fraction. Pioneer and Flyby effects [K17] allow to make a rough estimate for the size of this fraction and the outcome is about $2 \times 10^{-4}$ 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 [K20] 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 Kähler 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 $\lambda_\gamma^2$. 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 $\omega_R$ 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 peneration 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 $\Lambda$ 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 $\lambda_g$ 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 $5 \times 10^14$ 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 [K27] 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 $h_{eff} = nh$, and biophotons [K26, K25] identified as decay pro-

duces 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://en.wikipedia.org/wiki/Ionization_energy` ). The energies of molecular bonds are in the range 2-10 eV (`http://en.wikipedia.org/wiki/Bond-dissociation_energy` ). 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 $1.4 \times 10^6$ 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 $3 \times 10^3$ km. The radius of Earth is $6.37 \times 10^3$ 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 [L10] (`https://www.youtube.com/watch?v=i-T7tCMUDXU` ) 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 [K21] [L10].

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 Water Memory And Pre-Biotic Life

Pollack's findings [L10] discussed from TGD view point in [K15, K13] 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 $h_{eff}$.

## 3.1 Exclusion Zones As Prebiotic Cells

TGD based model model [L10], [K22] for Pollack's findings [L10] 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 $\mu$m 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 [K11, K8].

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.

## 3.2 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.

### 3.2.1 Summary of the basic facts and overall view

A concice summary of the basic qualitative facts about homeopathy [K8] 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 [I6]. Benveniste et al [I7] 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 [I11, I12].

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 [I4]. What I learned was what might be called scaling law of homeopathy [K8]. 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 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.

### 3.2.2 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 $h_{eff} = nh$ [K15, 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.

### 3.2.3 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 [K11].

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.

### 3.2.4 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.

## 3.3 Direct Empirical Evidence For Dark DNA?!

Sciencedaily tells about extremely interesting finding related to DNA (`http://www.sciencedaily.com/releases/2015/07/150722101813.htm#.Va_mQDnzazA.email`. The finding is just what breakthrough discovery should be: it must be something impossible in the existing world view.

What has been found [I13] (`http://www.nature.com/nature/journal/vaop/ncurrent/full/nature14580.html`) 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://www.wavegenetics.jino-net.ru`) [I8, I1] have first suggested? Also TGD leads to a vision about living system as a conscious hologram [K2]. 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.

### 3.3.1 Could transcription transform dark DNA to dark mRNA?

Also the TGD based notion of dark DNA comes in mind [K8, K11] (`http://www.tgdtheory.fi/public_html/hologram/hologram.html#homeoc`, `http://www.tgdtheory.fi/public_html/neuplanck/neuplanck.html#nuclstring`). 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 (https://www.youtube.com/watch?v=i-T7tCMUDXU [L10], [K29]). 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 knockout! 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.

### 3.3.2 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 [K5].

   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.

### 3.3.3 Could dark genetics help to understand wobble base pairing?

Wobble base pairing (https://en.wikipedia.org/wiki/Wobble_base_pair) 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 tRNAs 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 [K8] 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 [K11] 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 [K16] [L6] 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 [K9] (`http://www.tgdtheory.fi/public_html/hologram/hologram.html#molephoto`) 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://www.sciencemag.org/content/350/6256/94`) that brain cells have a mosaic like distribution of genomes (`http://www.sciencedaily.com/releases/2015/10/151001153931.htm`) . 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 [I8] 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?

## 3.4 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 [K23] [L8] 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 [I9, I17] support this view as also the findings of group of HIV Nobelist Montagnier [I11, I12].

## 3.5 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.

### 3.5.1 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 $h_{eff}/h = E_J/hf_{AC}$ [K24].

   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, K15]. 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 $\phi$ leads rather naturally to generation of large $h_{eff}$ [K9] when one requires internal consistency.

### 3.5.2 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 [K27, K15]. 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 [K28]. 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 [K28]. 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.

### 3.5.3 Exclusion zones as prebiotic cells

TGD based model model [L10], [K22] for Pollack's findings [L10] 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 $\mu$m 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 [K11, K8].

6. Negatively charged EZ could define a pre-biotic cell so that water would be a primitive pre-biotic 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.

### 3.5.4 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 [K8] 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].

### 3.5.5 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 $\rightarrow$ P-MG $\rightarrow$ ATP-MG $\rightarrow$ 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.

### 3.5.6 Could electrons serve as nutrients?

The New Scientist article 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 [K15] (see this and this ).

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 this and this ).

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 [K28]. 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 [K15]. 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.

## 3.6 Humble Origins Of DNA As Nutrient - Really Humble?

I received an interesting link (`http://www.spacedaily.com/reports/DNA_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 [I14]. 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, [K10] ) 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 [K29]. 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.

# 4 Jeremy England's Vision About Life And Evolution

I had an intensive discussion with my son-in-law Mikko about the work of Jeremy England [**?**] (`https://santitafarella.wordpress.com/2014/01/27/dissipation-driven-adaptive-organization-is-j`
The article of the link is probably the most aggressive hyping I have ever seen but this should not lead to think that a mere hype is in question. There is also another, not so heavily hyped popular article at `https://www.quantamagazine.org/20140122-a-new-physics-theory-of-life/`. The material at the homepageof england lab (`shttp://www.englandlab.com`) gives a good view about the work of England for those who cannot tolerate hyping.

England's work is indeed very interesting also from TGD point of view although it is based on standard physics.

In the sequel I will summarize this approach and compare it with TGD vision. The generalization of the thermodynamical approach to TGD framework leads to surprising new insights about the thermodynamical conditions making life and consciousness possible. The new elements relate to zero energy ontology (ZEO), hierarchy of Planck constants labelling levels in a hierarchy dark matters assignable with quantum criticality, the role of macroscopic quantum coherence associated with gravitation, and strong form of holography. The TGD counterparts of Hawking temperature and Hagedorn temperature seem to be crucial for life and correspond to physiological temperature scales. Near Hawking temperature the special features of ZEO become manifest meaning that time reversals of "selves" (mental images) are generated with a considerable rate in heat bath and long term memory and planned action become possible.

## 4.1 Basic Ideas Of England's Theory

I try first to summarize England's vision.

1. Non-equilibrium thermodynamics (NET) is the starting point. NET has been for decades the theoretical framework underlying the attempts to understand living matter using the principles of self-organization theory. Living matter is never an isolated system: dissipation would take it to a totally dead state in this case - nothing would move. Water in the pond when there is no wind, is a good example.

   Self-organization requires an external energy feed - gravitational potential energy liberated in water flow in river or electric power feed to the hot plate below a teapot. This energy feed drives the system to a non-stationary state far from a thermal equilibrium state. Dissipation polishes out all details and leads to an asymptotic spatio-temporal self-organization patterns. The flow in a river and convection in the heated teapot. With high enough energy feed chaos emerges: water fall or boiling of tea pot.

2. The basic hypothesis of England is that evolution means increase in the ability to dissipate. This looks intuitively rather obvious. The evolving system tends to get to a resonance with the energy feed by oscillating with the same frequency so that energy feed becomes maximal and therefore also dissipation. The basic rule is simple: choose the easy option, ride on the wave rather than fighting against it! For instance, the emergence of photosynthesis means that the systems we call plants become very effective in absorbing the energy of sunlight. In this framework essentially all systems are alive to some degree.

   Dissipation means generation of entropy. Evolution of life and conscious intelligence would mean maximal effectivenes in the art of producing disorder. Now I am perhaps exaggerating. One should speak about "system's maximal ability to transfer entropy out of it": life is not possible without paper baskets. One could argue that the development of civilization durig last decades demonstrates convincingly that evolution indeed generates systems generating disorder with a maximal rate.

   One could argue that the definition is too negative. Living matter is conscious and there is genuine conscious information present. The fact is that evolution involves a continual increase of conscious information: the exponential explosion of science is the best proof for this. England's vision says nothing about it. Something is missing.

   It is however quite possible to imagine that the principle of maximal entropy generation is true and that the increase of the ability to produce entropy is implied by some deeper principle allowing to speak about living matter as something tending to increase conscious information resources. To formulate this idea one needs a theory of consciousness, thermodynamics is not enough.

3. England has a further idea. The evolution life is not climbing to Mount Everest but coming down from it. Life emerges spontaneously. This is definitely in conflict with the standard wisdom, in particular with the thermodynamical belief on thermal death of the Universe as all gradients disappear. Darwinian evolution would be a special case of a more general phenomenon, which could be called dissipation driven adaptation (DDA). I made a head-on-collision with this principle in totally different framework by starting from quantum criticality of TGD: if took time to fully realize that indeed: evolution could be seen as a sequence of phase transitions breaking in which certain infinite-dimensional symmetry was spontaneously broken to become just the same symmetry but in longer scale!

   Standard thermodynamics predicts the heat death of the Universe as all gradients gradually disappear. This prediction is problematic for England's argument suggesting that differentiation occurs instead of homogenization. Here the standard view about space-time might be quite too simplistic to overcome the objection. In TGD many-sheeted space-time comes in rescue.

   Here is an example about England's argumentation. It seems intuitively clear that replication increases entropy (it is not however clear whether just the splitting into pieces is even more effective manner to increase entropy!). This would suggest that DDA forces the emergence of replication. Very effective dissipators able to replicate, would increase the total effectiveness in dissipation and be the winners. The proposal to be tested is that bacterial mutations , which are best replicators are also best dissipators.

## 4.2 What Is Missing From England's Theory?

What is missing from England's theory? The answer is same as the answer to the question what is missing from standard physics.

1. What is conscious observer - self?

   Observer, which remains outsider to the physical world in the recent day physics - both classical and quantum. Hence one does not have a theory of consciousness and cannot speak about conscious information. Thermodynamics gives only the notion of entropy as a measure for the ignorance.

   Therefore there is a long list of questions that England's theory does not address. What are the physical correlates of attention, sensory perception, cognition, emotions relating closely

to information, etc.? Is there some variational principle behing concious existence, and does it imply evolution? Could second law and DDA be seen as consequences of this variational principle?

England does not say much about quantum theory since he talks only about thermodynamics but his hypothesis is consistent with quantum theory. The restriction to thermodynamics allows only statistical description and notions like macroscopic quantum coherence are left outside.

2. What is life?

   Again one has a long list of questions.

   What it is to be alive? What distinguishes between living and inanimate systems. What it is to die? How general phenomenon evolution is: does it apply to all matter? Also notions like self-preservation and death are present only implicitly in an example about a population of wine glasses whose members might gradually evolve to survive in an environment populated by opera sopranos.

   One can make also other kinds of questions. What really happens in replication? What is behind genetic code? Etc...

   England is a spiritual person and has made clear that the gulf between science and spirituality is something which bothers him . England even has the courage to use the word "God". Therefore it sounds somewhat paradoxical that England avoids using the concepts related to consciousness and life. This is however the only option if one does not want to lose academic respectability.

## 4.3 How Does England's Theory Relate To TGD?

It is interesting to see whether England's vision is consistent with TGD inspired theory of consciousness, which can be also seen as a generalization of quantum measurement theory achieved by bringing the observer part of the quantum physical world. In TGD framework several new principles are introduced and they relate to the new physics implied by the new view about space-time.

1. The new physics involves a generalization of quantum theory by introducing a hierarchy of Planck constants $h_{eff} = n \times h$ with various quantal length and time scales are proportional to $h_{eff}$. $h_{eff}$ hierarchy predicts a hierarchy of quantum coherent systems with increasing size scale and time span of memory and planned action. $h_{eff}$ defining a kind of intelligence quotient labels the levels of a hierarchy of conscious entities.

   $h_{eff}$ hierachy labels actually a fractal hierarchy of quantum criticalities: a convenient analogy is a ball at a top of ball at the top..... The quantum phase transitions inreasing $h_{eff}$ occur spontaneously: this is the TGD counterpart for the spontaneous evolution in England's theory. Dark matter is what makes system alive and intelligent and thermodynamical approach can describe only what we see at the level of visible matter.

2. Second key notion is zero energy ontology (ZEO). Physical states are replaced by events, one might say. Event is a pair of states: initial state and final state. In ZEO these states correspond to states with opposite total conserved quantum numbers: positive and negative energy states. This guarantees that ZEO based quantum theory is consistent with the fundamental conservation laws and laws of physics as we understand them although it allows non-determinism and free will. Positive and negative energy states are localized at opposite boundaries of a causal diamond (CD). Penrose diagram - diamond symbol - is a good visualization and enough for getting the idea.

   State function CDreduction (SFR) is what happens in quantum measurement. The first SFR leads to a state which is one in a set of states determined once measurement is characterized. One can only predict the probabilities of various outcomes. Repeated quantum measurements leave the state as such. This is Zeno effect - watched kettle does not boil.

   In ZEO something new emerges. The SFR can be performed at *either* boundary of CD. SFR can occur several times at the same boundary so that the state at it does not change. The

state at the opposite boundary however changes - one can speak of the analog of unitary time evolution - and the second boundary also moves farther away. CD therefore increases and the temporal distance between its tips does so also.

The interpretation is as follows. The sequence of reductions at fixed bounary corresponds to a conscious entity, self. Self experiences the sequence of state function reductions as a flow of time. Sensory experience and thoughts, emotions, etc.. induced by it come from the moving boundary of CD. The constant unchanging part of self which meditators try to experience corresponds to the static boundary - the kettle that does not boil.

Self dies in the *first* reduction to the opposite boundary of CD. Self however re-incarnates. The boundaries of self change their roles and the geometric time identified as distance between the tips of CD increases now in opposite direction. Time-reversed self is generated.

3. Negentropy Maximization Principle (NMP) stating roughly that the information content of consciousness is maximal. Weak form of NMP states that self has free will and can choose also non-maximal negentropy gain. The basic principle of ethics would be "Increase negentropy". p-Adic mathematics is needed to construct a measure for conscious information and the notion of negentropic entanglement (NE) emerges naturally as algebraic entanglement.

   The negentropy to which NMP refers is *not* the negative of thermodynamical entropy describing lack of information of outsider about state of system. This negentropy characterizes the conscious information assignable to negentropic entanglement (NE) characterized by algebraic entanglement coefficients with measure identified as a number theoretic variant of Shannon entropy. Hence NMP is consistent with the second law implied by the mere non-determinism of SFR.

   NMP demands that self during sequence of reductions at the same boundary generates maximum negentropy gain at the changing CD boundary. If self fails, it dies and re-incarnates (in a reduction to the opposite CD boundary more negentropy is generated). Selves do not want to die and usually they do not believe on re-incarnation, and therefore do their best to avoid what they see as a mere death. This is the origin of self-preservation. Self must collect negentropy somehow: gathering negentropic sub-selves (mental images) is a manner to achieve this. Plants achieve this by photosynthesis, which means generation of negentropy and storage of it to various biomolecules. Animals are not so saintly and simply eat plants and even other animals. We are negentropy thieves all.

   Re-incarnation also means increase of $h_{eff}$ and getting to higher level in hierarchy and occurs unavoidably. As in England's theory, evolution occurs spontaneously: it is not climbing to Mount Everest but just dropping down.

4. England says "Some things we consider inanimate actually may already be 'alive'." This conforms with TGD view. Even elementary particles could have self: it is however not clear whether their SFR sequences contain more that one reduction to a fixed boundary - necessary for having a sense about the flow of time. Elementary particles would even cognize: in adelic physics every system has both real and p-adic space-time surfaces as its correlates. It can even happen that system has only p-adic space-time correlates but not the real one: this kind of systems would be only imaginations of real system! This is one of the most fascinating implications of strong form of holography which follows from strong form of General Coordinate Invariance forced by the new view about space-time.

   Clearly the notion of evolution generalizes from biological context to entire physics in TGD. One can speak about p-adic evolution and evolution as increase of $h_{eff}$. The most abstract formulation is number theoretical: evolution corresponds to the increase of the complexity of extension of rationals to which the parameters characterizing space-time surfaces belong to.

5. Does DDA emerge in TGD framework? NMP demands a lot of SFRs - also at the level of visible matter. The non-determimism of SFR alone means a loss of knowledge about the state of system and an increase of thermodynamical entropy so that living systems would generate entropy very effectively also in TGD Universe at the level of visible matter. If one believes that second law and NET imply DDA as England argues, then also TGD implies it at the level of visible matter. For dark matter the situation is different, since the outcome of

SFR is not not random anymore. Seen from TGD perspective England's vision misses what is essential for life - the generation of phases of matter identifiable as the mysterious dark matter.

6. England talks about God. In a theory of consciousness predicting infinite self hierarchy, it is easy to assign the attribute "divine" to the levels of consciousness above given level of hierarchy. Personally I have nothing against calling the Entire Universe "God".

   One could give NMP the role of God. For strong form of NMP SFR would be almost deterministic except for ordinary matter for which entanglement is not algebraic and is therefore entropic: the universe would the best possible one in dark sectors and the worst one in the visible matter sector - Heaven and Hell! Weak form of NMP makes possible even more effective generation of negentropy than its strong form but allows self to make also stupid things and even SFRs with a vanishing negentropy gain: the outcome is state with no entanglement (system is in very literal sense alone in this state). The world in dark matter sectors is not anymore the best possible one but can become better and does so in statistical sense.

7. Replication is a crucial aspect of being alive. England argues that DDA allows to understand its emergence but does not tell about its mechanism. In TGD framework replication can be understood as an analog of particle decay - say photon emission by electron. This requires however a new notion: magnetic body. In Maxwell's theory one cannot assign any field identity to a physical system but TGD view about space-time forces to assign to a given system its field/magnetic body. The replication occurs primarily at the level of magnetic body carrying dark matter as large $h_{eff}$ phases. Magnetic body replicates and ordinary visible matter self-organizates around the resulting copies of it. The dynamics of dark matter would induce also DNA replication, transcription and mRNA translation, and there are some indications that it is indeed "dark DNA" (dark proton sequences having DNA, RNA, amino-acids, and tRNA as biochemical counterparts), which determines what happens in transcription.

## 4.4 Could One Apply The Thermodynamical Approach Of England In TGD Framework?

It turns out possible to gain amazing additional insights about TGD inspired view of life and consciousness by generalizing England's approach [I20]. Several puzzling co-incidences find an explanation in the thermodynamical framework and the vision about solar system as a living quantum coherent entity gains additional support.

1. The situation considered in England's approach is a system - say biomolecule - in heat bath so that energy is not conserved due the transfer of energy between reactants and heat bath.

2. The basic equation is equilibrium condition for the reaction $i \to f$ and its time reversal $f^* \to i^*$. The initial and final state can be almost anything allowing thermodynamical treatment: states of biomolecule or even gene and its mutation. The ratio of the rates for the reaction and its time reversal is given by the ratio of the Boltzmann weights in thermal equilibrium:

$$\begin{aligned} \frac{R(i \to f)}{R(f^* \to i^*)} &= R \ , \\ R &= e^{-\frac{E_i - E_f}{T}} \ . \end{aligned} \tag{4.1}$$

   $E_i$ and $E_f$ denote the energies of initial and final state. This formula is claimed to hold true even in non-equilibrium thermodynamics. It is important that the ratio of the rates does not depend at all on various coupling constant parameters. The equilibrium condition must be modified if initial and final states are fermions but it is assumed that states can be described as bosons. Note that in heat bath even fermion number need not be conserved.

3. If the energy eigenstates are degenerate, the ratio $R$ of Boltzman factors must be modified to include the ratio of state degeneracies

$$R \to \frac{D(E_i)}{D(E_f)} \times e^{-\frac{E_i - E_f}{T}} \quad . \tag{4.2}$$

This generalization is essential in the sequel.

One can imagine two possible reasons for the presence of exponentially large factors compensating Boltzmann weights $D(E_i)$. The first reason is that for $h_{eff} = n \times h$ the presence of $n$-fold degeneracy due to the n-fold covering of space-time surface reducing to 1-fold covering at its ends at the ends of CD is essential. Second possible reason is that the basic object are magnetic flux tubes modellable as strings with exponentially increasing density of states. These mechanisms could quite well be one and same.

Consider now the basic idea inspired by this formula in TGD framework.

1. Since magnetic flux tubes are key entities in TGD inspired quantum biology, stringy dynamics suggests itself strongly. The situation thus differs dramatically from the standard biochemical situation because of the presence of dark matter at magnetic flux tubes to which one can assign fermion carrying strings connecting partonic 2-surfaces defining correlates for particles in very general sense.

2. The key aspect of stringy dynamics is Hagedorn temperature [B1, B2] (`http://rabiaaslam.weebly.com/uploads/7/1/4/3/7143240/stat_project.pdf`). Slightly below Hagedorn temperature the density of states factor, which increases exponentially, compensates for the Boltzmann factor. Hagedorn temperature is given by

$$T_{Hag} = \frac{\sqrt{6}}{2\pi} \frac{1}{\alpha'} \quad , \tag{4.3}$$

where $\alpha'$ is string tension. In superstring models the value of string tension is huge but in TGD framework the situation is different. As a matter fact, the temperature can be rather small and even in the range of physiological temperatures.

3. What makes $T_{Hag}$ so special is that in the equilibrium condition reaction and its reversal can have nearly the same rates. This could have profound consequences for life and even more - make it possible.

In ZEO based quantum measurement theory and theory of consciousness time reversal indeed plays key role: self dies in state function reduction to the opposite boundary of CD and experiences re-incarnation as a time-reversed self. This process is essential element of memory, intentional action, and also remote metabolism, which all rely on negative energy signals travelling to geometric past assignable to time reversed sub-selves (mental images). The above formula suggests that intelligent life emerges near $T_{Hag}$, where the time reversed selves are generated with high rate so that system remembers and pre-cognizes geometric future as it sleeps so that memory planned action are possible.

4. String tension cannot be determined by Planck length as in string models if it is to be important in biology. This is indeed the case in TGD based quantum gravity. The gravitational interaction between partonic 2-surfaces is mediated by fermionic strings connecting them. If string tension were determined by Planck length, only gravitational bound states of size of order Planck length would be possible. The solution of the problem is that the string tension for gravitational flux tubes behaves like $1/h_{eff}^2$.

In TGD framework string tension can be identified as an effective parameter in the expression of Kähler action as stringy action for preferred extremal strongly suggested by strong form of holography (SH) allowing the description of the situation in terms of fermionic strings and

partonic 2-surfaces or in terms of interiors of space-time surfaces and Kähler action. $1/h_{eff}^2$ dependence can be derived from strong form of holography [K28] assuming electric-magnetic duality for Kähler form, and using the fact that the monopoles associated with the ends have same magnetic and electric charges.

5. The discussion of the analog of Hawking radiation in TGD framework [K28], [L16] led to an amazing prediction: the TGD counterpart of Hawking temperature turns out to be in the case of proton very near to the physiological temperature if the big mass is solar mass. This suggests that the entire solar system should be regarded as quantum coherent living system. This is also suggested by the general vision about EEG [K4]. Could Hawking temperature be near to the Hagedorn temperature but below it?

One can make this vision more detailed.

1. In ZEO the notion of heat bath requires that one considers reactants as subsystems. The basic mathematical entity is the density matrix obtained by tracing over entanglement with environment. The assumption that dark matter is in thermal equilibrium with ordinary matter can be made but is not absolutely crucial. The reactions transforming visible photons to dark photons should take care of the equilibrium. One could even assume that the description applies even in case of the negentropic entanglement since thermodynamical entropy is different from entanglement entropy negative for negentropic entanglement.

2. In TGD inspired quantum biology one identifies the gravitational Planck constant introduced by Nottale with $h_{eff} = n \times h$ [K28, K17, K12]. The idea is simple: as the strength of gravitational interaction becomes so strong that perturbation series fails to converge, a phase transition increasing the Planck constant takes place. $\hbar_{gr} = GMm/v_0 = \hbar_{eff} = n \times \hbar$ implies that $v_0/c < 1$ becomes the parameter defining the perturbative expansion. $h_{gr}$ is assigned with the flux tubes mediating gravitational interaction and one can say that gravitons propagate along them.

   Note that this assumption makes sense for any interaction - say in the case of Coulomb interaction in heavy atoms: this assumption is indeed made in the model of leptohadrons [K19] predicting particles colored excitations of leptons lighter the weak bosons: this leads to a contradiction with the decay widths of weak bosons unless the colored leptons are dark. They would be generated in the heavy ion collisions when the situation is critical for overcoming the Coulomb wall.

   The cyclotron energy spectrum of dark particles at magnetic flux tubes is proportional to $h_{gr}/m$ does not depend on particle mass being thus universal. In living matter cyclotron energies are assumed to be in the energy range of bio-photons and thus includes visible and UV energies and this gives a constraint on $h_{gr}$ if one makes reasonable assumption about strengths of the magnetic fields at the flux tubes [K25]. Bio-photons are assumed to be produced in the transformation of dark photons to ordinary photons. Also (gravitational) Compton length is independent on particle mass being equal to $L_{gr} = GM/v_0$: this is crucial for macrosopic quantum coherence at gravitational flux tubes.

3. The basic idea is that Hawking radiation in TGD sense is associated with all magnetic flux tubes mediating gravitational interaction between large mass $M$, say Sun, and small mass $m$ of say elementary particle. How large $m$ can be, must be left open. This leads to a generalization of Hawking temperature [L16] assumed to make sense for all astrophysical objects at the flux tubes connecting them to external masses:

$$T_{GR} = \hbar \frac{GM}{r_S^2 2\pi} = \frac{\hbar}{8\pi GM} \quad . \tag{4.4}$$

   For Sun with Schwartschild radius $r_S = 2GM = 3$ km one has $T_{GR} = 3.2 \times 10^{-11}$ eV.

   Planck constant is replaced with $\hbar_{gr} = GMm/v_0 = \hbar_{eff} = n \times \hbar$ in the defining formula for Hawking temperature. Since Hawking temperature is proportional to the surface gravity

of blackhole, one must replace surface gravity with that at the surface of the astrophysical object with mass $M$ so that radius $r_S = 2GM$ of the blackhole is replaced with the actual radius $R$ of the astrophysical object in question. This gives

$$T_{Haw} = \frac{m}{8\pi v_0}(\frac{R_S}{R})^2 \quad . \tag{4.5}$$

The amazing outcome is that for proton the estimate for the resulting temperature for $M$ the solar mass, is 300 K (27 C), somewhat below the room temperature crucial for life!

Could Hagedorn temperature correspond to the highest temperature in which life is possible - something like 313 K (40 C)? Could it be that the critical range of temperatures for life is defined by the interval $[T_{Haw}, T_{Hag}]$? This would require that $T_{Haw}$ is somewhat smaller $T_{Hag}$. Note that Hawking temperature contains the velocity parameter $v_0$ as a control parameter so that Hawking temperature could be controllable. Of course, also $T_{Haw} = T_{Hag}$ can be considered. In this case the temperature of environment would be different from that of dark matter at flux tubes.

4. The condition $T_{Haw} \leq T_{Hag}$ allows to pose an upper bound on the value of the effective string tension

$$\frac{1}{\sqrt{\alpha'}} \geq \frac{m}{4\sqrt{6}v_0}\frac{R_S}{R} \quad . \tag{4.6}$$

# 5 About Statistics, Negentropic Entanglement, Hawking Radiation, And Firewall Paradox In TGD Framework

In quantum field theories (QFTs) defined in 4-D Minkowski space spin statistics theorem forces spin statistics connection: fermions/bosons with half-odd integer/integer spin correspond to totally antisymmetric/symmetric states. TGD is not a QFT and one is forced to challenge the basic assumptions of 4-D Minkowskian QFT. In the following it is show that the notion of many-shheeted space-time combined with strong form of holography (SH), Zero Energy Ontology (ZEO), Negentropy Maximization Principle (NMP), hierarchy of Planck constants $h_{eff} = n \times h$ with the identification of $h_{eff}$ as gravitational Planck constant $h_{gr} = GMm/v_0$, $v_0/c \leq 1$ challenges the standard form of spin and statistics connection, suggests that quantum gravitation in astrophysical scales could be highly relevant for life, and also leads to new views about firewall paradox.

1. In TGD framework the fundamental reason for the fermionic statistics are anticommutation relations for the gamma matrices of the "World of Classical Worlds" (WCW). This naturally gives rise to geometrization of the anticommutation relations of induced spinor fields at space-time surfaces. The only fundamental fields are second quantized space-time spinors, which implies that the statistics of bosonic states is induced from the fermionic one since they can be regarded as many-fermion states. At WCW level spinor fields are formally classical.

   Strong form of holography (SH) forced by strong form of General Coordinate Invariance (SGCI) implies that induced spinor fields are localized at string world sheets. 2-dimensionality of the basic objects (string world sheets and partonic 2-surfaces inside space-time surfaces) makes possible braid statistics, which is more complex than the ordinary one. The phase corresponding to $2\pi$ rotation is not $\pm 1$ but a root of unitary and the phase can be even replaced with non-commuting analog of phase factor.

   What about the ordinary statistics of QFTs expected to hold true at the level of imbedding space $H = M^4 \times CP_2$? Can one deduce it from the q-variants of anticommutation relations for fermionic oscillator operators - perhaps by a suitable transformation of oscillator operators? Is the Fermi/Bose statistics at imbedding space level an exact notion or does it emerge only at the QFT limit when many-sheeted space-time sheets are lumped together and approximated as a slightly curved region of empty Minkowski space?

2. Zero energy ontology (ZEO) means that physical systems are replaced by pairs of positive and negative energy states defined at the opposite boundaries of causal diamond (CD). CDs form a fractal hierarchy. Does this mean that the usual statistics must be restricted to coherence regions defined by CDs rather than assume it in entire H? This assumption looks reasonable since it would allow to milden the rather paradoxical looking implications of statistics and quantum identify for particles.

## 5.1 Negentropic Entanglement, Quantum Monogamy, And Biology

Interesting questions relate to the notion of negentropic entanglement (NE) and quantum monogamy.

1. Two states are negentropically entangled if their density matrix is proportional to projection operator and thus proportional to unit matrix. This require also algebraic entanglement coefficients. For bipartite entanglement this is guaranteed if the entanglement coefficients form a unitary matrix apart from normalization factor. The so called quantum monogamy theorem has a highly non-trivial implication for NE. In its mildest form it states that if two entangled systems are in a 2-particle state which is pure, the entire system must be de-entangled from the rest of the Universe. As a special case this applies to NE. A stronger form of monogamy states that two maximally entangled qubits cannot have entanglement with a third system. It is essential that one has qubits. For 3-valued color one can have maximal entanglement for 3-particle states (baryons). For instance, the negentropic entanglement associated with N identical fermions is maximal for subsystems in the sense that density matrix is proportional to a projection operator.

   Quantum monogamy could be highly relevant for the understanding of living matter. Biology is full of binary structures (DNA double strand, lipid bi-layer of cell membrane, epithelial cell layers, left and right parts of various brain nuclei and hemispheres, right and left body parts, married couples,... ). Could given binary structure correspond at some level to a negentropically entangled pure state and could the system at this level be conscious? Could the loss of consciousness accompany the formation of a system consisting of a larger number of negentropically entangled systems so that 2-particle system ceases to be pure state and is replaced by a larger pure state. Could something like this take place during sleep?

2. NE seems to relate also to the statistics. Totally antisymmetric many-particle states with permutations of states in tensor product regarded as different states can be regarded as negentropically entangled for any subsystem since the density matrix is projection operator. Here one could of course argue that the configuration space must be divided by the permutation group of $n$ objects so that permutations do not represent different states. It is difficult to decide which interpretation is correct so that let us consider the first interpretation.

   The traced out states for subsystems of many-fermion state are not pure. Could fermionic statistics emerge at imbedding space-level from the braid statistics for fundamental fermions and Negentropy Maximization Principle (NMP) favoring the generation of NE? Could CD be identified as a region inside which the statistics has emerged? Are also more general forms of NE possible and assignable to more general representations of permutation group? Could ordinary fermions and bosons be also in states for which entanglement is not negentropic and does not have special symmetry properties? Quantum monogamy plus purity of the state of conscious system demands decomposition into de-entangled sub-systems - could one identify them as CDs? Does this demand that the entanglement due to statistics is present only inside CDs/selves?

3. At space-time level space-time sheets (or space-like 3-surfaces or partonic 2-surfaces and string world sheets by SH) serve as natural candidates for conscious entities at space-time level. At imbedding space level elementary particles associated with various space-time sheets inside given CD would contain elementary particles having NE forced by statistics. But doesn't this imply that space-time sheets cannot define separate conscious entities?

   The notion of finite resolution for quantum measurement, cognition, and consciousness suggests a manner to circumvent this conclusion. One has entanglement hierarchies assignable to the length scale hierarchies defined by p-adic length scales, hierarchy of Planck constants

and hierarchy of CDs. Entanglement is defined in given resolution and the key prediction is that two systems unentangled in given resolution can be entangled in an improved resolution. The space-time correlate for this kind of situation are space-time sheets, which are disjoint in given resolution but contain topologically condensed smaller space-time sheets connected by thin flux tubes serving as correlates for entanglement.

The paradoxical looking prediction is that at a given level of hierarchy characterized by size scale for CD or space-time surface two systems can be un-entangled although their subsystems are entangled. This is impossible in standard quantum theory. If the sharing of mental images by NE between subselves of separate selves makes sense, contents of consciousness are not completely private as often assumed in theories about consciousness. For instance, stereo vision could rely on fusion and sharing of visual mental images assignable to left and right brain hemispheres and generalizes to the notion of stereo consciousness making to consider the possibility of shared collective consciousness. An interpretation suggesting itself is that selves correspond to space-time sheets and collective levels of consciousness to CDs.

Encouragingly, dark elementary particles would provide a basic example about sharing of mental images. Dark variants of elementary particles could be negentropically entangled by statistics condition in macroscopic scales and form part of a kind of stereo consciousness, kind of pool of fundamental mental images shared by conscious entities. This could explain why for instance the secondary p-adic time scale for electron equal to $T = .1$ seconds corresponds to a fundamental biorhythm.

## 5.2 Quantum Monogamy And Firewall Paradox

Quantum monogamy relates also to the firewall paradox of blackhole physics discussed from TGD viewpoint in [K28].

1. There are two entanglements involved. There is entanglement between Alice entering the blackhole and Bob remaining outside it. There is also the entanglement between blackhole and Hawking radiation implied if Hawking radiation is only apparently thermal radiation and blackhole plus radiation defines a pure quantum state. If so, Hawking evaporation does not lead to a loss of information. In this picture blackhole and Hawking radiation are assumed to form a single pure system.

   Since Alice enters blackhole (or its boundary), one can identify Alice as part of the modified blackhole being entangled with the original blackhole and forming a pure state. Thus Alice would form an entangled pure quantum state with both Bob and Hawking blackhole. This in conflict with quantum monogamy. The assumption that Alice and blackhole are un-entangled does not look reasonable. But why Alice, Bob and blackhole could not form pure entangled 3-particle state or belong to a larger entangled state?

2. In TGD framework the firewall problem seems to be mostly due to the use of poorly defined terms. The first poorly defined notion is blackhole as a singularity of GRT. In TGD framework the analog for the interiors of the blackhole are space-time regions with Euclidian signature of induced metric and accompany all physical systems. Second poorly defined notion is that of information. In TGD framework one can define a measure for conscious information using p-adic mathematics and it is non-vanishing for NE. This information characterizes always two-particle system - either as a pure system or part of a larger system. Thermodynamical negentropy formally defined as negative of entropy characterizes single particle (or ignorance about its state) in ensemble so that the two notions are not equivalent albeit closely related. Further, in the case of blackhole one cannot speak of information going down to blackhole with Alice since information is associated with a pair formed by Alice and some other system outside blackhole like objects or perhaps at its surface. Finally, the notion is hierarchy of Planck constants allows NE in even astrophysical scales. Therefore entangling Bob, Alice, and TGD counterpart of blackhole is not a problem. Hence the firewall paradox seems to dissolve.

3. The hierarchy of Planck constants $h_{eff} = n \times h$ connects also with dark quantum gravity via the identification $h_{eff} = h_{gr}$, where $h_{gr} = 2\pi GMm/v_0$, $v_0/c \leq 1$, is gravitational Planck

Planck constant. $v_0/c < 1$ is velocity parameter characterizing system formed by the central mass $M$ and small mass $m$, say elementary particle.

This allows to generalize the notion of Hawking radiation [K29] (see this, this, and this ), and one can speak about dark variant of Hawking radiation and assign it with any material object rather than only blackhole. The generalized Hawking temperature is proportional to the mass m of the particle at the gravitational flux tubes of the central object and to the ratio $R_S/R$ of the Schwartschild radius $R_S$ and radius $R$ for the central object. Amazingly, the Hawking temperature for solar Hawking radiation in the case of proton corresponds to physiological temperature. This finding conforms with the vision that bio-photons result from dark photons with $h_{eff} = h_{gr}$. Dark Hawking radiation could be very relevant for living matter in TGD Universe!

Even more, by extending [K29] (see this and this) Jeremy England's vision about life [I20] (`http://tinyurl.com/o64rd7o`), one ends up via SH to suggest that the Hawking temperature equals to the Hagedorn temperature assignable to flux tubes regarded as string like objects! This assumption fixes the value of string tension and is highly relevant for living matter in TGD Universe since it guarantees that subsystems can become time-reversed with high probability in state function reduction. The frequent occurrence of time reversed mental images makes possible long term memory and planned action and one ends up with thermodynamics of consciousness. This is actually not new: living systems are able to defy second law and the notion of syntropy was introduced long time ago by Fantappie [J3].

4. Does one get rid of firewall paradox in TGD Universe? It is difficult answer the question since it is not at all clear that there exists any paradox anymore. For instance, the assumption that blackhole represents pure state looks in TGD framework rather ad hoc and the NE between blackhole and other systems outside it looks rather natural if one accepts the hierarchy of Planck constants.

   It would however seems to me that the TGD analog of dark Hawking radiation along flux tubes is quite essential for communications and even more, for what it is to be Alice and Bob and even for their existence! The flux tube connections of living systems to central star and planets could be an essential part of what it is to be alive as I have already earlier suggested with the inspiration coming from $h_{eff} = h_{gr}$. In this framework biology and astrophysics would meet in highly non-trivial manner.

# 6 More Precise View About Remote DNA Replication

Both Luc Montagnier [I11, I12] and Peter Gariaev [I15] have found strong evidence for what might be called remote replication of DNA. I have developed a TGD inspired model for remote replication using the data from Peter Gariaev [K30], who has developed the notion of wave DNA [I8] supported by Montagnier's findings.

Polymer chain reaction (PCR) [I2] provides a manner to build copies of piece of DNA serving as template. Once single copy is produced, it serves as a template for a further copy so that exponential amplification is achieved. Montagnier's and Gariaev's works suggest however that the synthesis of DNA could also occur without a real matrix DNA as remote replication. According to the proposal of Gariaev [I8, I19] DNA template would be remotely represented as what he calls wave DNA. Montagnier [I12] uses 7 Hz ELF radiation to obtain the effect whereas Gariaev [I15] uses scattering of laser light into large interval of frequencies to achieve the effect.

In TGD approach magnetic body containing dark matter with large Planck constant, the associated cyclotron radiation for which energy scale is proportional to effective Planck constant $h_{eff} = n \times h$ having large values implying conjectured macroscopic quantum coherence of living matter, dark analog of DNA represented as dark proton sequences at magnetic flux tubes and accompanying ordinary DNA, plus reconnection of U-shaped magnetic flux tubes assignable to the magnetic bodies of biomolecules and allowing them to recognize each other, are the basic elements. The model has evolved from the attempts to understand water memory and homeopathy in TGD framework [K8].

Both 7 Hz ELF radiation and scattering of laser light would both generate dark photon (large Planck constant) spectrum with a wide spectrum of frequencies but with the same energy which

in Gariaev's experiments would naturally be the energy of scatter laser light. The dark photons would provide representation for DNA codons. If 7 Hz frequency radiation involves dark photons with energies of visible photons transforming to ordinary photons before scattering from DNA the outcome would be same as in Gariaev's experiments.

This picture conforms with Gariaev's hologram idea and also with TGD based vision about living matter as a conscious hologram [K2]. The laser beam that Gariaev has used and the 7 Hz irradiation (involving dark ELF photons at bio-photon energies) would act as a reference beam allowing to read a biohologram coded by DNA and its magnetic body. The outcome is dark photons with same energy but with varying values of Planck constant and thus with varying frequencies propagating along magnetic flux tubes to the target, which could be exclusion zone (EZ). Flux tubes are characterised by $h_{eff}$ and magnetic field strength $B_{end}$ determining cyclotron frequency (coded by the transversal area by flux quantization if monopole flux is in question). Metabolic energy is needed to create EZ and could be provided either by the radiation itself or by the repeated heating. Negentropic entanglement is generated and creates the correlation between dark (phantom) DNA codons and ordinary DNA codons.

The following involves same elements as the model discussed in [K30] but there are also new elements due to the developments in the model of dark DNA allowing to imagine a detailed mechanism for how water can represent DNA and how DNA could be transcribed to dark DNA. The transcription/association represents a rule and rules are represented in terms of negentropic entanglement in TGD framework with pairs of states in superposition representing the instances of the rule. Transition energy serves as a characterizer of a molecule - say DNA codon - and the entangled state is a superposition of pairs in which either molecule is excited or dark DNA codon is excited to higher cyclotron state with same energy: this requires tuning of the magnetic field and sufficiently large value of $h_{eff}$ at the flux tube. Negentropic entanglement is due to the exchange of dark photons: this corresponds to wave DNA aspect. Dark cyclotron photons also generate negatively charged exclusion zones (EZs) discovered by Pollack and in this process transform part of protons to dark ones residing at the magnetic flux tubes associated with EZs and forming dark proton sequencies.

## 6.1 Some Background

The model for remote replication involves the following basic building bricks.

1. Dark variant of DNA realized as dark proton strings representing dark nuclei.
2. The identification of bio-photons as decay products of dark cyclotron photons with large value of $h_{eff}$ having universal energy spectrum due to the condition $h_{eff} = h_{gr}$.
3. TGD explanation for the fourth phase of water discovered by Pollack [L10] and characterized by negatively charged exclusion zones EZs generated by radiation.
4. A model for the radiative coding of DNA creating 1-1 correlation between ordinary and dark DNA codons and between two dark DNA codons.

### 6.1.1 Dark DNA as dark proton strings

TGD leads to a model of nuclei as nucleons strings [K11]. The model generalizes to the dark matter sector [K11, K8].

1. I have proposed the notion of dark DNA realized as dark proton sequences (3 quark states), which I have argued ton basis of a simple model to form representations for DNA, RNA, amino-acids and even tRNA is central for TGD inspired biology. Biochemistry would define only a secondary representation for more fundamental realization of genetic code and analogs of basic biomolecules in terms of dark nuclear physics.

   I have conjectured that translations, transcription, etc generalize and apply to pairs of ordinary and dark and dark and dark DNA and amino-acids. One could even consider that dark DNA would make possible induction of genetic changes: transfer dark DNA inside germ cells and transform them to ordinary DNA and attach to existing DNA. If dark DNA can

be generated by radiation as wave DNA notion suggests then radiation from other cells to germ cells could induced genetic changes. Living systems would have kind of Research and Discovery apartment developing new candidates for genes. Evolution would be the opposite for blind random trials.

2. I have also proposed that immune system could have developed from what is basic mechanism of homeopathy and water memory. The magnetic bodies of water clusters mimic invader molecules - or rather their magnetic bodies. What is needed is a representation for cyclotron frequencies so that radiation would emerge in this phase. Cyclotron frequency spectrum would represent the invader and the simplest mimicry of invader molecule would be water structure with magnetic body characterized by same cyclotron frequency spectrum: water memory in short. Also the braiding of the magnetic body of the invader might be mimicked.

   Protein folding might be a chemical representation for this braiding and the proteins of immune system might mimic the braidings of the magnetic bodies of the invader molecules. DNA in turn would give a symbolic representation of proteins allowing to construct them when needed. Ordinary DNA and proteins would have been preceded by dark DNA and dark proteins. I have even proposed an interpretation of genetic code based on the idea that it represents the dynamical evolution of braiding of the magnetic body - or 2-braiding [K23].

   The basic mechanism of directed attention or sensing the presence of the invader molecule would be reconnection of U shape flux tubes of the magnetic bodies of the two system. Also resonant interaction by cyclotron radiation inducing cyclotron transitions is expected to be an essential piece of the mechanism. Magnetic body of water cluster could tune the thickness of flux tube so that the magnetic field is same as that in the flux tube of invader molecule so that primitive consciousness and act of free will would be involved.

3. Suppose that DNA codes for proteins, their cyclotron frequency spectrum and their braiding and knotting in protein folding in turn representing invader molecule. Is the frequency spectrum all that is needed to represent DNA and construct its dark variant? The experiments of Benveniste and followers [I6, I7] suggest that invader molecules are indeed represented by the cyclotron frequency spectrum alone. This would suggest connection with wave DNA concept.

### 6.1.2 Universality of cyclotron energy spectrum and bio-photons as decay products of dark photons

There are good empirical motivations [K29] to expect that the cyclotron energy spectrum is universal and in the range of bio-photon energy spectrum. This is achieved if $h_{eff}$ is proportional to the mass $m$ of the charged particle so that cyclotron energy $\hbar_{eff}eB/m$ is independent of mass and same for all charged particles.

Universality follows also from the condition that gravitational and biological Planck constants are identical: $h_{gr} = h_{eff}$, where $\hbar_{gr} = GMm/v_0$ is the gravitational Planck constant introduced by Nottale and assigned with the flux tubes mediating gravitational interaction in TGD Universe. The condition states that electromagnetic and gravitational flux tubes have same the value of effective Planck constant meaning that also gravitation would become a key player in biology.

### 6.1.3 Fourth phase of water, EZs, and metabolic role of cyclotron radiation

The experiments of Pollack [L10] suggest a partial answer to the question. in terms of what he calls fourth phase of water containing negatively charged regions, exclusion zones (EZ) of size up to 200 micrometers.

1. Irradiation of water by visible light generates negatively charged regions which he calls exclusion zones (EZs). The energy goes to the formation of electric voltage between exterior and interior and is analogous to cell membrane potential. Predecessor of cell could be in question. Some fraction of protons must go outside the system and my proposal is that it goes to magnetic flux tubes and forms dark proton sequences defining the analogs of basic bio-molecules. The $H_{1.5}O$ stoichiometry of EZs [L10] characterizing also earlier findings suggesting that one fourth of protons of water are dark in attosecond time scale (not visible

in electron scattering and neutron diffraction) suggests that every fourth proton disappears from EZ. This anomaly was one of the strong motivations for taking the idea about dark matter as large $h_{eff}$ phases seriously [K6].

These structures would be involved also with water memory and homeopathy and immune system would have emerged from these. Free energy researchers know these regions quite well [**?**] (no-one of course takes them seriously!) and they can be generated by just feeding energy to system used as metabolic energy. In homeopathy the mechanical agitation would do this and induce replication and perhaps even evolution of the resulting primitive lifeforms. Cavitation, use of strong electric field, maybe even heating used in PRC, etc... are possible mechanisms of energy feed.

2. The cyclotron radiation at cyclotron frequencies associated with flux tubes emanating from DNA codons could provide the energy needed to induce the formation of EZs. This would be the first function for the radiation.

3. If the DNA end of flux tube contains dark proton in state which corresponds to the DNA in one-one manner then the mass of the dark proton state would assign to it a unique cyclotron frequency distinguishing between DNA codons. The challenge is to understand the mechanism of DNA dark DNA pairing and dark DNA-dark DNA pairing and one expects resonant binding by exchange of dark cyclotron photons.

### 6.1.4 Pairing ordinary and dark DNA codons and two identical dark DNA codons by negentropic entanglement

One should understand the pairing of ordinary and dark DNA. As a matter fact, this pairing defines a realization of the genetic code as a physical 1-1 correlation of DNA codons with some physical states. I have consider this kind of realizations also in the model of DNA as topological quantum computer. The following realization relies on resonant interaction by exchange of dark cyclotron photons and can be seen as radiation based.

1. The most natural association between ordinary and dark DNA would via energy resonance. The energy for some molecular transition of DNA (in bio-photon energy range by argument below) would be same as cyclotron energy for the codon with large value of $h_{eff} = n \times h$ making cyclotron energy large.

2. By suitably tuning the value of the magnetic field $B$ associated with the flux tube accompanying ordinary DNA codon the dark cyclotron energy can be tuned to be equal to the value of some biochemical transition energy of DNA, which is in visible and UV range typically - that is in the energy range of bio-photons.

3. Classically DNA codon and its dark variant can be thought of as exchanging forth and back dark photon at resonance frequency and become strongly correlated in this manner like tennis players during game. Quantum mechanically one has quantum entangled Schrödinger cat like state in which state pairs have same total energy but individual states do not have well-defined energy.

4. The correlation between dark proton states at two ends of flux tube would be realized as formation of bound state via resonant exchange of dark cyclotron photons. Negentropically entangled [K10] superposition for which simplest the possible form is $|n\rangle|n+1\rangle + |n+1\rangle|n\rangle$ of paired cyclotron states would be generated. DNA and dark DNA codons would pair to a negentropically entangled state in similar manner. Recall that in TGD framework negentropic entanglement (NE) carries potentially conscious information: the state represents a rule whose instances correspond to the state pairs in the superposition [K10].

5. One can consider also 3-particle NE of DNA codon and 2 dark DNA codons which is superposition of three 3-particle states with one particle excited to higher energy state with the same energy. DNA codon would be excited chemically and dark codons excited to cyclotron state ($n \to n+1$). 3-dimensional permutation symbol defines this kind of state. Also NE for larger number of particles is possible.

The tuning of the flux tube magnetic field to make cyclotron energy equal to chemical transition energy is possible for arbitrary biochemical transition energies and the association of dark proton states to arbitrary biomolecules is in principle possible via same mechanism. This would be essentially a symbolic representation of biomolecule, a name for molecule. If one has some number of different molecules able to form sequences, these sequences can be remotely reconstructed by using the cyclotron frequencies and transversal flux tubes associated with the template to generate the EZs and the name of the polymer to which the building bricks bind resonantly.

If the condition $h_{eff} = h_{gr}$ holds true, one can use instead of dark proton sequences sequences of *any* dark charged particles - say electrons and ions. Hence almost an unlimited repertoire of representations arises. These correspondences need not to be one-one. For instance, DNA-amino-acid 64-to-20 correspondence is possible to realize with the help of dark variants of DNA codons and amino-acids and also the partially or totally dark variants of this correspondence are possible.

This pairing mechanism would allow resonant interactions of the ordinary DNA codons in water and dark DNA codons induced by the dark cyclotron radiation and could play key role also in ordinary DNA replication and also in the remote replication reported by Montagnier [I12] and Gariaev [K30]. A phase transition reducing $h_{eff}$ would bring ordinary and dark codon together and ordinary biochemistry would take care of the rest. Clearly, this mechanism would also allow biomolecules connected by magnetic flux tubes to find each other in molecular soup with pairing following by a phase transition reducing $h_{eff}$.

## 6.2 Does Remote Replication Apply Same Mechanism As MimicryOf Invader Molecules In The Case Of Water Memory?

Somehow the irradiation of water sample with the cyclotron radiation generated by real DNA should induce or be involved with the generation of dark DNA representing the ordinary DNA and the PCR process would use this dark DNA as template an involves pairing of ordinary and dark DNA nucleotides. How this could happen in TGD Universe?

The mechanism of remote DNA replication without chemical template would be essentially the same as in the TGD based model of water memory [K8] underlying also the model of homeopathy circumventing the ultra-naive skeptic argument that homeopathy is not possible because the density of molecules dissolved in water is practically zero.

The cyclotron frequency spectrum allows to create EZ whose magnetic body mimics the invader molecule. Resonant formation of negentropically entangled pairs would define a realization of genetic code based on radiation and dark cyclotron radiation would give rise to the formation of EZs and accompanying dark proton sequences.

In the recent case invader molecule would be replaced with DNA expressing its presence using dark cyclotron radiation propagating along the flux tubes transversal to codons and forming part of the magnetic body of DNA. The magnetic flux tube of ordinary DNA codon realizing dark proton sequence as dark variant of DNA codon would generate its own representation by generating EZs in water.

The rules would be following.

1. Magnetic fields at U-shaped flux tubes associated with codons and dark codons must be equal so that also cyclotron frequencies coding for dark proton masses and therefore for dark proton states would be equal so that frequency and energy resonance is possible and negentropically entangled state is formed. This assigns by resonance mechanism to the second end of flux tube same dark proton state as to the end near ordinary DNA. Recall that U-shape is essential for bio-super-conductivity based on large value of $h_{eff}$ making possible large and negative spin-spin interaction energy for electrons of pair located at parallel flux tubes [K3, K14].

   As described, binding is generated by resonant exchange of dark cyclotron photons between the ends which are in superposition of different cyclotron states. Magnetic field value in turn corresponds directly to ordinary DNA codon - or rather its transition in bio-photon energy range. It is essential that the value of magnetic field codes for ordinary DNA codon via a biochemical transition energy associated with it. One can imagine that magnetic body can tune the value of field by changing the transversal area of the flux tube carrying monopole flux (possible in TGD due to the $CP_2$ topology). Similar tuning would be involved when

the magnetic bodies assignable to EZs detect possible invader molecules. Interestingly, the impurity molecules inside EZs are removed by unknown mechanism citebbioPollackYoutube.

2. Dark DNA codons associated with DNA would have U-shaped flux tubes which for large $h_{eff}$ would extend to the water sample containing building bricks of DNA and catalyst. The flux tubes associated with dark DNA and building bricks of ordinary DNA would reconnect resonantly and lead to remote replication of DNA strand.

This option is definitely not the only possibility one can imagine but represents the general principle. For instance, one can consider using only DNA-dark DNA complex and inducing $h_{eff}$ increasing phase transition transferring the dark DNA strand to the volume of the water sample. The mechanism allows also to consider remote translation of genes to proteins. The possible medical applications of this in a situation in which the DNA of the patient has suffered a mutation causing a disease are obvious.

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

There is a talk of Mae-Wan Ho (`https://www.youtube.com/watch?v=QufAlEqUZmU&app=desktop` ) 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 [I18] has proposed that there exists superconducting liquid crystal water aligned with collage fibres. Giudice et al [I5] 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 [I23, I21] 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 [K29, K23].

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 [K18] 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 [K29]. 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.

## 7.1 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.

## 7.2 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 biosystems - 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!

### 7.3 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.

## 8 Was Ribosome The First Self-Replicator?

In the group Thinking Allowed Original there as a link to a popular article describing a highly interesting work [I22] 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.

## 8.1 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 [I22] 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 [K7]. 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 $X \to RNA - X - amino - acid$ 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.

## 8.2 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.

### 8.2.1 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.

### 8.2.2 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.

### 8.2.3 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 [K28].

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 . [K23]. 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.

# 9 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.

## 9.1 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 [I10] (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.

## 9.2 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?

### 9.2.1 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 [L21]. 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 [L18].

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.

### 9.2.2 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 [L10] (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 [L10]. 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 [L17] (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.

### 9.2.3 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 [L22, L23] "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 the emergence of chemical storage of energy used dark nucleosynthesis [L19] (see `http://tinyurl.com/y7u5v7j4`) as the source of metabolic energy. The recently discovered life-like properties [I16] 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 [L20] (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.

### 9.2.4 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.

### 9.2.5 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.

### 9.2.6 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.

### 9.2.7 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 $h_{eff}/h = n$.

# REFERENCES

## Theoretical Physics

[B1] Rafelski J Ericson T. The tale of the Hagedorn temperature. *Cern Courier* . Available at: http://www.cerncourier.com/main/toc/43/7, 43(7), 2002.

[B2] Chaudar RA. Thermodynamics of Strings and Hagedorn Temperature. Available at: http://rabiaaslam.weebly.com/uploads/7/1/4/3/7143240/stat_project.pdf, 2012.

## Cosmology and Astro-Physics

[E1] Nottale L Da Rocha D. Gravitational Structure Formation in Scale Relativity. Available at: http://arxiv.org/abs/astro-ph/0310036, 2003.

[E2] Tajmar M et al. Experimental Detection of Gravimagnetic London Moment. Available at: http://arxiv.org/abs/gr-gc0603033, 2006.

[E3] Tate J et al. *Phys Rev*, 62(8), 1989.

[E4] Matos de CJ Tajmar M. Local Photon and Graviton Mass and Its Consequences. Available at: http://arxiv.org/abs/gr-gc0603032, 2006.

## Biology

[I1] Brief introduction into WaveGenetics. Its scope and opporturnities. Available at: http://www.wavegenetics.jino-net.ru.

[I2] Polymerase chain reaction. Available at: http://en.wikipedia.org/wiki/PCR.

[I3] The Fourth Phase of Water : Dr. Gerald Pollack at TEDxGuelphU. Available at: https://www.youtube.com/watch?v=i-T7tCMUDXU, 2014.

[I4] Smith C. *Learning From Water , A Possible Quantum Computing Medium.* CHAOS, 2001.

[I5] Tedeschi Alberto Emilio Del Giudice, Paola Rosa Spinetti. Article: Water Dynamics at the Root of Metamorphosis in Living Organisms. *Water* . Available at: http://www.mdpi.com/journal/water, 2:566–586, 2010.

[I6] Benveniste J et al. Human basophil degranulation triggered by very dilute antiserum against IgE. *Nature*, 333:816–818, 1988.

[I7] Benveniste J et al. Transatlantic transfer of digitized antigen signal by telephone link. *J Allergy and Clinical Immunology.* Available at: http://www.digibio-.com/, 99:175, 1989.

[I8] Gariaev P et al. *The DNA-wave biocomputer*, volume 10. CHAOS, 2001.

[I9] Gariaev PP et al. The spectroscopy of bio-photons in non-local genetic regulation. *J Non-Locality and Remote Mental Interactions.* Available at: http://www.emergentmind.org/gariaevI3.htm, (3), 2002.

[I10] Gibard C et al. Phosphorylation, oligomerization and self-assembly in water under potential prebiotic conditions. *Nature Chemistry. doi:10.1038/nchem.2878*, 2017.

[I11] Montagnier L et al. Electromagnetic Signals Are Produced by Aqueous Nanostructures Derived from Bacterial DNA Sequences. *Interdiscip Sci Comput Life Sci .* Available at: http://www.springerlink.com/content/0557v31188m3766x/, 2009.

[I12] Montagnier L et al. DNA waves and water. Available at: http://arxiv.org/abs/1012.5166, 2010.

[I13] Steinier YR et al. Genetic compensation induced by deleterious mutations but not gene knockdowns. *Nature. doi:10.1038/nature14580*, 2015.

[I14] Zerulla K et al. Dna as a phosphate storage polymer and the alternative advantages of polyploidy for growth or survival. *PLOS one*, 9(4), 2014.

[I15] Bludorf F Fozar G. Scientists prove DNA Can Be Reprogrammed by Words and Frequencies, 2014.

[I16] Gogia G and Burton JC. Emergent Bistability and Switching in a Nonequilibrium Crystal. arXiv.org. Available at: http://tinyurl.com/ychho4l8, 2017.

[I17] Tovmash AV Gariaev PP, Tertishni GG. Experimental investigation in vitro of holographic mapping and holographic transposition of DNA in conjuction with the information pool encircling DNA. *New Medical Technologies*, 9:42–53, 2007.

[I18] Mae-Wan Ho. Super-Conducting Liquid Crystalline Water Aligned with Collagen Fibres in the Fascia as Acupuncture Meridians of Traditional Chinese Medicine. *Forum on immunopathological diseases and therapeutics.* Available at: http://dl.begellhouse.com/journals/1a654bf03faf67ac,744ec0d724b32947.html, 3(3-4):221–236, 2012.

[I19] Gariaev P. Materialization of DNA Fragment and Wave Genetics in Theory and Practice. *DNADJ.* Available at: http://www.amazon.com/Decipher-Journal-Volume-Issue-Materialization/dp/1500127493, 4(1), 2014.

[I20] England J Perunov N, Marsland R. Statistical Physics of Adaptation. Available at: http://arxiv.org/pdf/1412.1875v1.pdf, 2014.

[I21] Zhao Q Pollack GH, Figueroa X. Molecules, water, and radiant energy: new clues for the origin of life. *Int J Mol Sci* Available at: http://tinyurl.com/ntkfhlc, 10:1419–1429, 2009.

[I22] Root-Bernstein R Root-Bernstein M. The ribosome as a missing link in the evolution of life. *J Theor Biol.* Available at: http://www.sciencedirect.com/science/article/pii/S0022519314006778, 367(21):130158, 2015.

[I23] Pollack GH Zheng J-M. Long-range forces extending from polymer-gel surfaces. *Phys Rev E* Available at: http://tinyurl.com/ntkfhlc, 68:031408–, 2003.

## Neuroscience and Consciousness

[J1] Dias BB and Ressler KJ. Parental olfactory experience influences behavior and neural structure in subsequent generations. *Nature. Neuroscience*, 17:89–96, 2014.

[J2] Lodato MA et al. Somatic mutation in single human neurons tracks developmental and transcriptional history. *Science.* Available at: http://www.sciencemag.org/content/350/6256/94, 350(6256):94–98, 2015.

[J3] Fantappie L. *Teoria Unitaria del Mondo Fisico e Biologico.* Di Renzo Editore, Roma, 1942.

# Books related to TGD

[K1] Pitkänen M. About Strange Effects Related to Rotating Magnetic Systems . In *TGD and Fringe Physics*. Online book. Available at: http://tgdtheory.fi/public_html/freenergy/freenergy.html#Faraday, 2006.

[K2] Pitkänen M. Bio-Systems as Conscious Holograms. In *Bio-Systems as Conscious Holograms*. Online book. Available at: http://tgdtheory.fi/public_html/hologram/hologram.html#hologram, 2006.

[K3] Pitkänen M. Bio-Systems as Super-Conductors: part I. In *Quantum Hardware of Living Matter*. Online book. Available at: http://tgdtheory.fi/public_html/bioware/bioware.html#superc1, 2006.

[K4] Pitkänen M. Dark Matter Hierarchy and Hierarchy of EEGs. In *TGD and EEG*. Online book. Available at: http://tgdtheory.fi/public_html/tgdeeg/tgdeeg.html#eegdark, 2006.

[K5] Pitkänen M. DNA as Topological Quantum Computer. In *Genes and Memes*. Online book. Available at: http://tgdtheory.fi/public_html/genememe/genememe.html#dnatqc, 2006.

[K6] Pitkänen M. Does TGD Predict the Spectrum of Planck Constants? In *Hyper-finite Factors and Dark Matter Hierarchy*. Online book. Available at: http://tgdtheory.fi/public_html/neuplanck/neuplanck.html#Planck, 2006.

[K7] Pitkänen M. Evolution in Many-Sheeted Space-Time. In *Genes and Memes*. Online book. Available at: http://tgdtheory.fi/public_html/genememe/genememe.html#prebio, 2006.

[K8] Pitkänen M. Homeopathy in Many-Sheeted Space-Time. In *Bio-Systems as Conscious Holograms*. Online book. Available at: http://tgdtheory.fi/public_html/hologram/hologram.html#homeoc, 2006.

[K9] Pitkänen M. Macroscopic Quantum Coherence and Quantum Metabolism as Different Sides of the Same Coin: Part II. In *Bio-Systems as Conscious Holograms*. Online book. Available at: http://tgdtheory.fi/public_html/hologram/hologram.html#molephoto, 2006.

[K10] Pitkänen M. Negentropy Maximization Principle. In *TGD Inspired Theory of Consciousness*. Online book. Available at: http://tgdtheory.fi/public_html/tgdconsc/tgdconsc.html#nmpc, 2006.

[K11] Pitkänen M. Nuclear String Hypothesis. In *Hyper-finite Factors and Dark Matter Hierarchy*. Online book. Available at: http://tgdtheory.fi/public_html/neuplanck/neuplanck.html#nuclstring, 2006.

[K12] Pitkänen M. Quantum Astrophysics. In *Physics in Many-Sheeted Space-Time*. Online book. Available at: http://tgdtheory.fi/public_html/tgdclass/tgdclass.html#qastro, 2006.

[K13] Pitkänen M. *Quantum Hardware of Living Matter*. Online book. Available at: http://tgdtheory.fi/public_html/bioware/bioware.html, 2006.

[K14] Pitkänen M. Quantum Model for Bio-Superconductivity: I. In *TGD and EEG*. Online book. Available at: http://tgdtheory.fi/public_html/tgdeeg/tgdeeg.html#biosupercondI, 2006.

[K15] Pitkänen M. Quantum Model for Bio-Superconductivity: II. In *TGD and EEG*. Online book. Available at: http://tgdtheory.fi/public_html/tgdeeg/tgdeeg.html#biosupercondII, 2006.

[K16] Pitkänen M. Quantum Model for Hearing. In *TGD and EEG*. Online book. Available at: http://tgdtheory.fi/public_html/tgdeeg/tgdeeg.html#hearing, 2006.

[K17] Pitkänen M. TGD and Astrophysics. In *Physics in Many-Sheeted Space-Time*. Online book. Available at: http://tgdtheory.fi/public_html/tgdclass/tgdclass.html#astro, 2006.

[K18] Pitkänen M. *TGD and EEG*. Online book. Available at: http://tgdtheory.fi/public_html/tgdeeg/tgdeeg.html, 2006.

[K19] Pitkänen M. The Recent Status of Lepto-hadron Hypothesis. In *Hyper-finite Factors and Dark Matter Hierarchy*. Online book. Available at: http://tgdtheory.fi/public_html/neuplanck/neuplanck.html#leptc, 2006.

[K20] Pitkänen M. WCW Spinor Structure. In *Quantum Physics as Infinite-Dimensional Geometry*. Online book. Available at: http://tgdtheory.fi/public_html/tgdgeom/tgdgeom.html#cspin, 2006.

[K21] Pitkänen M. Meditation, Mind-Body Medicine and Placebo: TGD point of view. In *TGD based view about living matter and remote mental interactions*. Online book. Available at: http://tgdtheory.fi/public_html/tgdlian/tgdlian.html#panel, 2012.

[K22] Pitkänen M. Quantum Mind and Neuroscience. In *TGD based view about living matter and remote mental interactions*. Online book. Available at: http://tgdtheory.fi/public_html/tgdlian/tgdlian.html#lianPN, 2012.

[K23] Pitkänen M. Quantum Mind, Magnetic Body, and Biological Body. In *TGD based view about living matter and remote mental interactions*. Online book. Available at: http://tgdtheory.fi/public_html/tgdlian/tgdlian.html#lianPB, 2012.

[K24] Pitkänen M. About Concrete Realization of Remote Metabolism. In *Bio-Systems as Conscious Holograms*. Online book. Available at: http://tgdtheory.fi/public_html/hologram/hologram.html#remotetesla, 2013.

[K25] Pitkänen M. Are dark photons behind biophotons. In *TGD based view about living matter and remote mental interactions*. Online book. Available at: http://tgdtheory.fi/public_html/tgdlian/tgdlian.html#biophotonslian, 2013.

[K26] Pitkänen M. Comments on the recent experiments by the group of Michael Persinger. In *TGD based view about living matter and remote mental interactions*. Online book. Available at: http://tgdtheory.fi/public_html/tgdlian/tgdlian.html#persconsc, 2013.

[K27] Pitkänen M. TGD and Potential Anomalies of GRT. In *Physics in Many-Sheeted Space-Time*. Online book. Available at: http://tgdtheory.fi/public_html/tgdclass/tgdclass.html#granomalies, 2013.

[K28] Pitkänen M. Criticality and dark matter. In *Hyper-finite Factors and Dark Matter Hierarchy*. Online book. Available at: http://tgdtheory.fi/public_html/neuplanck/neuplanck.html#qcritdark, 2014.

[K29] Pitkänen M. Quantum gravity, dark matter, and prebiotic evolution. In *Genes and Memes*. Online book. Available at: http://tgdtheory.fi/public_html/genememe/genememe.html#hgrprebio, 2014.

[K30] Gariaev P Pitkänen M. Quantum Model for Remote Replication. In *Genes and Memes*. Online book. Available at: http://tgdtheory.fi/public_html/genememe/genememe.html#remotereplication, 2011.

## Articles about TGD

[L1] Pitkänen M. Bio-catalysis from primitive immune system.Available at: http://www.tgdtheory.fi/webCMAPs/Bio-catalysisfromprimitiveimmunesystem.html. 2014.

[L2] Pitkänen M. Biophotons.Available at: http://www.tgdtheory.fi/webCMAPs/Biophotons.html. 2014.

[L3] Pitkänen M. CMAP representations about TGD. Available at: http://www.tgdtheory.fi/cmaphtml.html, 2014.

[L4] Pitkänen M. CMAP representations about TGD, and TGD inspired theory of consciousness and quantum biology. Available at: http://www.tgdtheory.fi/tgdglossary.pdf, 2014.

[L5] Pitkänen M. Differences between TGD and string models.Available at: http://www.tgdtheory.fi/webCMAPs/DifferencesbetweenTGDandstringmodels.html. 2014.

[L6] Pitkänen M. Geometric theory of harmony. Available at: http://tgdtheory.fi/public_html/articles/harmonytheory.pdf, 2014.

[L7] Pitkänen M. Gravitational anomalies.Available at: http://www.tgdtheory.fi/webCMAPs/Gravitationalanomalies.html. 2014.

[L8] Pitkänen M. Morphogenesis, morphostasis, and learning in TGD framework. Available at: http://tgdtheory.fi/public_html/articles/morpho.pdf, 2014.

[L9] Pitkänen M. Origin of genetic code.Available at: http://www.tgdtheory.fi/webCMAPs/Originofgeneticcode.html. 2014.

[L10] Pitkänen M. Pollack's Findings about Fourth phase of Water : TGD View. Available at: http://tgdtheory.fi/public_html/articles/PollackYoutube.pdf, 2014.

[L11] Pitkänen M. Quantum biology.Available at: http://www.tgdtheory.fi/webCMAPs/Quantumbiology.html. 2014.

[L12] Pitkänen M. Quantum gravity and biology.Available at: http://www.tgdtheory.fi/webCMAPs/Quantumgravityandbiology.html. 2014.

[L13] Pitkänen M. Quantum model of EEG.Available at: http://www.tgdtheory.fi/webCMAPs/QuantummodelofEEG.html. 2014.

[L14] Pitkänen M. Water memory and homeopathy.Available at: http://www.tgdtheory.fi/webCMAPs/Watermemoryandhomeopathy.html. 2014.

[L15] Pitkänen M. Zero Energy Ontology (ZEO).Available at: http://www.tgdtheory.fi/webCMAPs/ZeroEnergyOntology(ZEO).html. 2014.

[L16] Pitkänen M. TGD view about blackholes and Hawking radiation. Available at: http://tgdtheory.fi/public_html/articles/hawkingnew.pdf, 2015.

[L17] Pitkänen M. About Physical Representations of Genetic Code in Terms of Dark Nuclear Strings. Available at: http://tgdtheory.fi/public_html/articles/genecodemodels.pdf, 2016.

[L18] Pitkänen M. Hydrinos again. Available at: http://tgdtheory.fi/public_html/articles/Millsagain.pdf, 2016.

[L19] Pitkänen M. Cold fusion, low energy nuclear reactions, or dark nuclear synthesis? Available at: http://tgdtheory.fi/public_html/articles/krivit.pdf, 2017.

[L20] Pitkänen M. Life-like properties observed in a very simple system. Available at: http://tgdtheory.fi/public_html/articles/plasticballs.pdf, 2017.

[L21] Pitkänen M. Mysteriously disappearing valence electrons of rare Earth metals and hierarchy of Planck constants. Available at: http://tgdtheory.fi/public_html/articles/rareearth.pdf, 2017.

[L22] Pitkänen M. Philosophy of Adelic Physics. In *Trends and Mathematical Methods in Interdisciplinary Mathematical Sciences*, pages 241–319. Springer.Available at: https://link.springer.com/chapter/10.1007/978-3-319-55612-3_11, 2017.

[L23] Pitkänen M. Philosophy of Adelic Physics. Available at: http://tgdtheory.fi/public_html/articles/adelephysics.pdf, 2017.