Quantum Model for Remote Replication

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Abstract

A model for remote replication of DNA is proposed. The motivating experimental discoveries are phantom DNA, the evidence for remote gene activation by scattered laser light from similar genome, and the recent findings of Montagnier's and Gariaev's groups suggesting remote DNA replication.

Phantom DNA is identified as dark nucleon sequences predicted by quantum TGD with dark nucleons defining naturally the analogs of DNA, RNA, tRNA, and amino-acids and realization of vertebrate genetic code. The notion of magnetic body defining a hierarchy of flux quanta realize as flux tubes connecting DNA nucleotides contained inside flux tubes connecting DNA codons and a condensed at flux sheets connecting DNA strands is an essential element of the model. Dark photons with large value of Planck constant coming as integer multiple of ordinary Planck constant propagate along flux quanta connecting biomolecules: this realizes the idea about wave DNA. Biomolecules act as quantum antennas and those with common antenna frequencies interact resonantly.

Biomolecules interacting strongly - in particular DNA nucleotides- would be characterized by same frequency. An additional coding is needed to distinguish between nucleotides: in the model for DNA as topological quantum computer quarks (u,d) and their antiquarks would code for the nucleotides A,T,C, and G would take care of this. The proposed role of quarks in biophysics of course makes sense only if one accepts the new physics predicted by quantum TGD. DNA codons (nucleotide triplets) would be coded by different frequencies which correspond to different values of Planck constant for photons with same photon energy propagating along corresponding flux tubes. This allows to interpret the previously proposed TGD based realization of so called divisor code proposed by Khrennikov and Nilsson in terms of quantum antenna mechanism. Years later from this proposal a much more detailed mode emerged leading to a formula for $h_{eff} = n \times h$ making h_{eff} proportional to the mass (number) of the charged particle involved. This predicts universal energy spectrum for dark photons in the range of visible and UV photons. Dark photons can transform to ordinary ones in energy conserving manner and the outcome is identified as biophotons.

In this framework the remote replication of DNA could be understood. DNA nucleotides interact resonantly with DNA strand and attach to the ends of the flux tubes emerging from DNA strand and organized on 2-D flux sheets. In Montagnier's experiment the interaction between test tubes A and B would be mediated by dark photons between DNA and dark nucleon sequences and amplify the dark photon beam, which in turn would induce remote replication. In the experiment of Gariaev scattered laser light would help to achieve the same purpose. Dark nucleon sequences would be generated in Montagnier's experiment by the homeopathic treatment of the test tube B.

Dark nucleon sequences could characterize the magnetic body of any polar molecule in water and give it a "name" written in terms of genetic codons so that genetic code would be much more general than usually thought. The dark nucleon sequence would be most naturally assigned with the hydrogen bonds between the molecule and the surrounding ordered water being perhaps generated when this layer of ordered water melts as the molecule becomes biologically active. Water memory and the basic mechanism of homeopathy would be due to the "dropping" of the magnetic bodies of polar molecules as the water is treated homeopathically and the dark nucleon sequences could define an independent life form evolving during the sequence of repeated dilutions and mechanical agitations taking the role environmental catastrophes as driving force of evolution. The association of DNA, RNA and amino-acid sequences associated with the corresponding dark nucleon sequences would be automatic since also also they are polar molecules surrounded by ordered water layers.

The transcription of the dark nucleon sequences associated the with the polar invader molecule to ordinary DNA sequences in turn coding of proteins attaching to the invader molecules by the quantum antenna mechanism could define the basic mechanism for functioning and evolution of the immune system.

1 Introduction

The idea about remote replication, transcription and translation of genes in terms of electromagnetic field patterns is very attractive and would be in accordance with the wave DNA vision. This requires a coding of DNA nucleotides. I have proposed several codings of this kind.

1. In DNA as topological quantum computer model [K13] quark and anti-quark at the ends of a flux tube connecting DNA nucleotide to a lipid of the nuclear or cell membrane takes care

of the coding. Also sequences of dark nucleons giving rise to dark nuclei realize the analogs of DNA, RNA, tRNA, and amino-acids as well as vertebrate genetic code [K17], [K5]. Dark nucleons sequences could correspond to the phantom DNA discovered by Gariaev's group [I6].

2. Quantum antenna hypothesis represents one of the oldest ideas of TGD inspired quantum biology [K7]: molecules would act like quantum antennas. Frequency coding would be very natural for groups of molecules participating in the same reaction: the flux tubes connecting the molecules would carry the radiation inducing resonant antenna interaction and phase transitions reducing Planck constant would bring the reacting molecules near to each other. Magnetic flux tubes connecting the molecules would be essential element of the mechanism. Remote replication would represent an example about a situation in which $\hbar$ changing phase transition does not take place. If one wants coding of individual molecules -such as DNA nucleotides- by frequency in turned coded by the value of $\hbar$ for given photon energy ($E = hf$), one is forced to make ad hoc assumptions and it is difficult to find any plausible scenario. Quantum antenna mechanism could make possible remote replication for which the findings of Montagnier's group as well as remote transcription for which the work of Gariaev's group gives some evidence.

3. One can consider also a coding by field patterns. In fact, the quark and antiquark at the ends of the flux tube generate a color magnetic field coding for the quark pair since the classical color field depends on the color of the quark and its antiquark. Gariaev's group has proposed that the change of polarization direction could provide a possible mechanism of coding of DNA sequences to radiation patterns [I5]. The proposal is discussed from TGD point of view in [K10]. The mechanism changing the polarization direction should reduce to different propagation velocities for the two circular polarizations. The other polarization should act more strongly with the DNA related structures and this should cause the slowing down of propagation since it would correspond to sequence of absorptions and emissions. The constraint that this occurs coherently for DNAs and codes the DNA sequence is very powerful condition. It is however difficult to imagine how this mechanism alone could give rise to remote replication of DNA or similar processes: the coding from radiation pattern to DNA sequences is the bottle neck. Therefore this mechanism will not be discussed in the following.

1.1 The original model of remote replication

In the sequel a model for the coding of DNA in terms of radiation patterns is discussed. There are three experimental guidelines: the phantom DNA [I6] identified as dark nucleon sequences in TGD framework and the evidence for remote activation of DNA transcription [I5] - both discovered by Gariaev's group - are assumed as the first two key elements of the model. The remote replication of DNA suggested by the experimental findings of Montagnier's group serves as a further guideline in the development of the model. Also the results of the latest experiment of Gariaev's group in many respects similar to that of Montagnier's experiment but differing in certain crucial aspects from it are used as input.

Polymerase chain reaction (PCR) (see `http://tinyurl.com/ybv6mn5l`) is the technique used in the experiments of Montagnier's group [I1] and later in somewhat modified experiment by Gariaev's group involving irradiation of the second test tube by laser light. DNA polymerase catalyzes the formation of DNA from existing DNA sequences serving as a template. Since the catalytic interaction of DNA polymerase takes place with already existing DNA sequence, the only possibility is that first some conjugate DNA sequences are generated by remote replication after which DNA polymerase uses these sequences as templates to amplify them to original DNA sequences. Whether the product consists of original DNA or its conjugate can be tested.

The model inspires the proposal that the magnetic body of a polar molecule codes for it using dark nucleon sequences assignable to the hydrogen bonds between the molecule and surrounding ordered water layer. Quantum antenna mechanism would allow the immune system to modify itself by developing ordinary DNA coding for amino-acids attaching to and thus "catching" the polar molecule. The mechanism could be behind water memory and homeopathic healing. The most general option is that every polar molecule in living matter would be accompanied by a dark nucleon sequence or several of them (as in the case of amino-acids) serving as its name. This

would also associate a unique dark nucleon sequence also with the magnetic body of DNA so that DNA-dark DNA association would be automatic. Same applies to mRNA and tRNA and amino-acids.

Remark: The first part of the chapter is essentially the article published together with Peter Gariaev in DNA Decipher journal [L19]. The considerations described below reflect the more recent views about remote replication.

1.2 Further developments of the model for remote replication

1.2.1 A more detailed model for the remote replication inspired by the findings of Luc Montangier's group

The findings of Montagnier et al [I9] (`http://arxiv.org/abs/1012.5166`) raise the possibility of remote replication of DNA. Montangier's experiment involves two chambers A and B. A contained water and genes and B water and DNA nucleotides. There were channels between the chambers but so thin that DNA could not get through. Also an em field with 7 Hz frequency was present. Same genes as in A appeared also in B. As if remote replication of genes in A had happened in B. I have written articles about Montagnier's findings [L1, L4]. Gariaev has reported a similar phenomenon already before Montagnier et al: we wrote together with Peter Gariaeb an article discussing the TGD based model for the finding [L19].

The model for remote replication discussed below is a modification of a model developed earlier together with Peter Gariaev on basis of his findings and involves the following basic building bricks.

1. In TGD inspired vision about quantum biology relying on the notion of magnetic body (MB) carrying dark matter as phases of ordinary matter with effective Planck constant $h_{eff} = n \times h_0$ one ends up with the notion of dark DNA realized as sequences of dark protons and to the surprising finding that dark proton triplets realize vertebrate genetic code and basic biomolecules DNA,RNA,tRNA, and amino-acids [L8, L11].

2. Second realization of the genetic code is using dark photon 3-chords [L6, L7, L3]. The allowed 3-chords of icosahedral code realized as a Hamiltonian cycle define a harmony with 20 chords and having as a symmetry subgroup Z_6, Z_4 or Z_2 of icosahedral geometry. The harmony is fixed by a Hamiltonian cycle of icosahedron defining a 12-note scale. Tetrahedral harmony has 4 chords and is unique. The symmetry group acts on the frequencies of the chord as a scaling and this is realized if the scale is obtained by quint cycle using octave equivalence.

   The fusion of 3 icosahedral codes with different symmetries with tetrahedral code gives rise to bio-harmony with 64 chords. Genetic codons are identified as allowed 3-chords and amino-acids as orbits of codons. The number of codons at the orbit of given codon would correspond to the number of DNA codons coding for amino-acid and the predicted numbers are correct for the vertebrate code under rather general assumption although also the variants of the code can be understood as being due to the failure of exact mimicry of dark photon code by the chemical realization. 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 $h_{eff} = h_{gr}$ [K16].

   A model for the radiative coding of DNA creating 1-1 correlation between ordinary and dark DNA codons and between two dark DNA codons.

3. TGD explanation [L5] for the fourth phase of water discovered by Pollack [L5, I12] and characterized by negatively charged exclusion zones EZs generated by radiation.

1.2.2 Galois confinement and (remote) replication in codon-wise manner

TGD predicts two dark variants of genetic code realized as dark codons (DDNAs) identified either as dark proton triplets or dark photon 3-chords. The objection against dark photon 3-chords (3-photon states) is that the simultaneous emission of 3 dark photons is extremely non-probable. The proposed solution of the problem is that dark photons carry a number theoretic color associated witha Z_3 sub-group of the Galois group. Number theoretic color confinement would imply that only 3-chords can appear as asymptotic states analogous to baryons as 3-quark states. If also

the dark protons form a number-theoretic color triplet, dark codons must consistof 3 protons and therefore also ordinary codons would have 3 letters.

The findings of Gariaev's group and Montagnier et al suggest the possibility or remote replication of DNA. The fact that dark codons do not decompose into letters like chemical codons poses strong constraints on the replication and transcription if one assumes DDNA-DNA-pairing. These constraints strongly suggestthat the nucleotides in the water environment of DNA are not actually free but form loosely bound triplets representing codons bound with DDNAs. Replication is predicted to occur in a codon-wise manner: this has been observed to be possible for RNA. It might be that the loose nature of exotic DNA codons allows this to occur quite generally.

Remote replication in this framework reduces to ordinary replication in TGD sense if also dark genes are present and formed by attaching flux tubes characterizing dark codons to a long flux tube associated with a gene. Remote replication requires that the portion of dark gene accompanying the ordinary gene is transferred from chamber A to chamber B in the experiment of Montagnier.

1.2.3 Codon-wise replication of RNA in lab

It is possible to replicate unfolded RNA strands in lab by using enzymes known as ribozymes, which are RNA counterparts of enzymes, which are amino acid sequences. In the presence of folding the replication is however impossible. Since ribozymes are in general folded, they cannot thus catalyze their own replication in this manner. However, it has been discovered that the replication using RNA triplets - genetic codons - as a basic unit can be carried out in labeven for the folded RNA strands and with a rather low error rate. Also the ribozyme involved can thus replicate in a codon-wise manner. For units longer than 3 nucleotides the replication becomes prone to errors.

The TGD based model for the findings relies on the vision that there are several realizations of the counterparts of DNA, RNA, tRNA, and amino-acids and of the genetic code so that chemical code is only one particular realization. For the dark realization in terms of entangled dark proton triplets one cannot analyze the codons to triplets of ordered letters so that codon is the smallest unit. This motivates the question whether RNA replication during the proposed RNA era happened in a codon-wise manner and relied on pre-tRNA in which amino-acid catalyzed the addition of RNA of tRNA to RNA sequence. The second possibility would be that replication occurs for dark codons basically so that ordinary letter-wise replication for DNA would actually occur codon-wise. The nucleotides in the water environment of genes would combine with scaled up dark codons to form "loose" variants of ordinary codons having no valence bonds between the nucleotides.

The crucial evolutionary step would have been analogous to the emergence of written language in which words decomposed into letters meaning a transition from RNA era to DNA era and DNA replication and transcription in a letter-wise fashion. At this step DNA and RNA polymerase and DNA helicase emerged. This picture is discussed from the point of view of the realization of the code in terms of 3-chords formed from dark photons. The 12-note scale forming the basis of the model of bio-harmony based on 64 chord harmony emerges naturally.

The appendix of the book gives a summary about basic concepts of TGD with illustrations. Pdf representation of same files serving as a kind of glossary can be found at `http://tgdtheory.fi/tgdglossary.pdf` [L2].

2 The Findings That One Should Understand

It is good to start by summarizing the experimental findings that the model should explain.

1. One should be able to identify phantom DNA [I6]. This identification explains the findings about phantom DNA if ordinary and dark DNA have common resonance frequencies and therefore behave like resonantly interacting quantum antennae.

2. The earlier findings of Gariaev's group suggesting remote gene expression [I5], which becomes also possible if the DNAs of the sender can activate the DNA of the receiver by radiation. Direct activation could be based on electromagnetic signal between DNA of the sender and ordinary conjugate DNA of the receiver. Scattering from ordinary and possibly also phantom DNA and would generate this kind of signal. The challenge is to explain why the activation

obeys genetic code in the sense that a given DNA sequence activates only similar DNA sequence.

3. The claim of Montagnier's team [I8, I9] is that the radiation generated by DNA affects water in such a manner that it behaves as if it contained the actual DNA. A brief summary of experiment of Montagnier and collaborators is in order.

   (a) Two test tubes containing 100 bases long DNA fragments were studied. Both tubes were subjected to 7 Hz electromagnetic radiation. Earth's magnetic field was eliminated to prevent its possible interference (the cyclotron frequencies of Earth's magnetic field are in EEG range and one of the family secrets of biology and neuroscience since seventies is that cyclotron frequencies in magnetic fields have biological effects on vertebrate brain). The frequencies around 7 Hz correspond to cyclotron frequencies of some biologically important ions in the endogenous magnetic field of.2 Tesla explaining the findings. This field is 2/5 of the nominal value of the Earth's magnetic field.

   (b) What makes the situation so irritating for skeptics who have been laughing for decades for homeopathy and water memory is that the repeated dilution process used for the homeopathic remedies was applied to DNA in the recent case. The solution containing no detectable amounts DNA (dilution factor was 10^{-12}) was placed in second test tube whereas the first test tube contained 100 bases long DNA in the original concentration.

   (c) After 16 to 18 hours both tubes were subjected to polymerase chain reaction (PCR), which builds DNA from its basic building bricks using DNA polymerase enzyme. What is so irritating from the point of view of skeptic was that DNA was generated also in the test tube containing the highly diluted water. Water in presence of second test tube seems to be able to cheat the polymerase by mimicking the presence of the actual DNA serving in the usual situation as a template for builing copies of DNA. One could also speak about the analog quantum teleportation. Note that the presence of both test tubes - and therefore some kind of communication between the samples - is absolutely esential for the process to take place: repeated dilution is not enough.

4. Peter Gariaev's team has carried out an analogous experiment recently in which one has two test tubes containing water. Tube A contained DNA fragments and tube B contained only water and DNA nucleotides plus DNA polymerase - just as as in Montagnier's experiment. The analog of the homeopathic procedure was not however applied to tube B. The experiments use a drop of DNA in water in gamma concentration in tube A. This DNA (with length of 600 base pairs) was scanned by laser radiation from helium-neon laser. The scattered radiation having a wide spectrum of frequencies down to kHz frequencies was applied on tube B at distance of 3 m in refrigerator (+4 Celsius) containing distilled water solution of DNA nucleotides and DNA polymerase inducing polymer chain reaction PCR amplifying DNA template if present. The generation of DNA sequences in tube B with the same mass distribution as in tube A by polymer chain reaction (PCR) is observed suggesting that the necessary DNA template is generated as a direct copy or conjugate of the original in test tube A by some unknown mechanism. Nucleotide sequences have not been analyzed to see whether they are identical or conjugates of those in tube A.

3 The Model Of Remote Replication Consistent With DNA As Topological Quantum Computer Model

The basic assumptions are that the scattered radiation, the flux tubes of the magnetic body of DNA along which the radiation propagates, and quarks and antiquarks at the ends of the flux tubes from system able to serve as a template for the formation of conjugate of ordinary DNA. To understand how remote remote replication could take place, some further assumptions are necessary.

1. The flux tubes emanating from DNA are parallel and condensed at 2-D flux sheet having DNA at is first boundary so that DNA nucleotides can attach to the flux tubes at the second boundary. The attached nucleotides would be along the same line and would form DNA sequence in remote replication process.

2. Quantum antenna interaction takes place between group of molecules participating a given reaction so that they have common antenna frequency as resonance frequency. The frequencies characterize the radiation propagating along magnetic flux tubes connecting the molecules, and could come as sub-harmonics of the frequency of (in the case considered) visible light from the formula

$$E = h_n f, \;\; h_n = nh \;\; , \;\; n = 1, 2, 3, ... \;\; .$$

Here E is the fixed energy of photon. h_n denotes value of Planck constant which in TGD Universe can have infinite number of values coming as multiplies of the ordinary Planck constant h.

For a given photon energy E one obtains harmonics of the basic wavelength

$$\lambda = \frac{c}{f(n)} = n\lambda_0 \;\; .$$

Wave length would correspond to the length of the flux tube proportional to n. DNAs with flux tubes characterized by different values of n would correspond to different levels in the evolutionary hierarchy. In TGD inspired theory of consciousness the value of h_n serves as the measure for the time scale of planned action and memory span and neurons of frontal lobe would represent the highest level in the hierarchy,

3. If resonance frequency is same for all nucleotides, frequency cannot distinguish between DNA nucleotides. In the model of DNA as topological quantum computer the quark (u or d) and antiquark ($\overline{u}$ or $\overline{d}$) at the ends of the flux tube code for A, T, C, G. This model is the simplest one and does not require any additional assumptions about frequency coding. It also allows resonant interaction at several frequencies: the scattering of visible light from DNA indeed produces a wide spectrum of frequencies interpreted in terms of dark variants of visible photons.

   One can criticize the assumption that particular quark or antiquark is associated with the flux tube ending at particular nucleotide. At this moment this assumption does not have a convincing dynamical explanation. Presumably this explanation would rely on the minimization of the interaction energy.

4. What is needed is a model explaining why the resonant antenna frequency does not depend on nucleotide: obviously the frequency should relate to something shared by all nucleotides. An energy level associated with sugar-phosphate backbone of DNA is what comes first in mind. A more exotic option is transition involved with quark-antiquark pair. Since electromagnetic field for non-vacuum extremals is accompanied by classical color field, the exchange of gluons between quark and antiquark suggests itself as the quantum antenna interaction distinguishing between nucleotides.

Quantum antenna mechanism is extremely general and flexible and might be a fundamental mechanism of bio-catalysis allowing also communication between visible and dark matter sectors. Antenna mechanism is of course central also in ordinary communications. If the biologically most relevant interactions of biomolecules via quantum antenna mechanism then also water memory and the claimed effects of homeopathically treated water might be understood [K5]. The testing of the dark photon aspect of the hypothesis would require the detection of the dark photons somehow: the decay to a bunch of n ordinary photons with same wavelength is the obvious manner to achieve this.

3.1 Identification Of Phantom DNA

The observed residual coherent scattering from a chamber from which ordinary DNA is removed inspired the notion of phantom DNA [I6]. The questions are what phantom DNA is and is it relevant to remote replication of the ordinary DNA.

Phantom DNA observed in the scattering experiments could correspond to dark nucleon sequences realizing vertebrate genetic code with dark nucleons consisting of three quarks representing

both DNA, RNA, tRNA, and amino-acids as particular nucleon states [K15, K5]. The resonant interaction between ordinary and dark DNA would explain why light at same frequencies scatters also from dark DNA in phantom DNA experiments. In Montagnier's experiments it could give rise to a positive feedback amplifying the radiation from second sample containing DNA. Water would be living in the sense that it contains "dark DNA" and dark DNA might allow remote transcription to ordinary DNA sequences in presence of ordinary DNA codons (triplets) and vice versa.

Skeptic can of course ask whether one could explain the experimental findings without assuming phantom DNA.

1. In Gariaev's experiments [I6], which inspired the notion of phantom DNA part of DNA could "drop" to parallel space-time sheets and have the same effect on the scattered radiation as the ordinary DNA. This explanation would however require the many-sheeted space-time of TGD - probably equally abominable to skeptic as phantom DNA.

2. In Montagnier's experiment and also in the recent experiment of Gariaev the ordinary DNA contained by water droplet could diffuse to dark space-time sheets and enter from flux tube A to flux tube B along the same magnetic flux tubes as radiation propagates. DNA polymerase would allow to amplify this leaking DNA and produce conjugate DNA. The irradiation of the original DNA would generate the flux sheets serving as a route for the transfer. The killer test is to check whether it is indeed conjugate of the original DNA which is produced. Again many-sheeted space-time is required.

3. For the option based on DNA as topological quantum computer hypothesis discussed above the remote replication would take place via the direct formation of conjugate DNA template and DNA polymerase produces from this copies of the *original* DNA whereas for "trivial" option conjugate DNA is produced. Phantom DNA would not be absolutely necessary. It is however questionable whether the intensity of the radiation is high enough and the resonant interaction with phantom DNA which could give rise to a positive feedback might be needed to amplify the radiation.

3.2 Dark DNA And Frequency Coding By Quantum Antenna Mechanism

The remote transcription of dark DNA (phantom DNA) to ordinary DNA and vice versa would have quite far reaching implications for evolution since dark DNA/RNA/tRNA/amino-acids could define a virtual world serving as $R\&D$ lab where new DNAs could be developed and if needed translated to ordinary DNA. The dark DNA could be also transferred through cell membranes without difficulty, in particular to germ cells. Also the genetic transfer between different organisms would become possible. Second possibility is that the magnetic flux tubes mediating the dark photons traverse the cell membranes so that even the transfer of dark nucleons through the cell membrane is un-necessary. The implications for genetic engineering would be obvious.

Could one generalize the quantum antenna mechanism to the interaction between dark nucleons representing DNA triplets as entangled states of three quarks and ordinary DNA codons consisting of three unentangled nucleotides? Could similar mechanism realize genetic code assigning to dark DNA dark variants of RNA, tRNA and amino-acids via the analogs of transcription and translation processes? It seems that frequency coding, which - somewhat disappointingly - did not look natural for remote replication of ordinary DNA, is ideal for these processes so that the original idea of wave DNA would be realized at the level of dark-visible and dark-dark interactions.

The flux tubes would be associated with entire codons -DNA triplets - rather than individual nucleotides. Different DNA triplets do not form interacting groups in the sense that they should be connected by flux tubes. Therefore the simplest possibility would be frequency coding with specific resonance frequency for each DNA triplet. No quarks at the ends of the flux tubes connecting codons are needed.

Remark: : A hierarchy of flux quanta is essential and must distinguish between its levels. Flux tubes associated with nucleotides at flux tubes associated with DNA codons at flux sheets traversing DNA strands.

If one assumes that octaves correspond to the same frequency this would require odd multiples

$$\lambda(n) = (2n+1)\lambda_0 \quad , \quad n = 0, ..., 63$$

of λ_0 so that the longest wavelength would be $127\lambda_0$. In the number theoretic model of the genetic code based on the notion of Combinatorial Hierarchy [K4] codons are indeed labeled by 64 integers in the range $0, ..., 127 = 2^7 - 1$. These integers are however not assumed to be odd. One can also consider the possibility that the frequencies are coded by the value of Planck constant and this option leads to an interpretation of the earlier proposed realization of divisor code [K17] to be discussed later on.

Support for this option comes from the phenomenon of phantom DNA demonstrating that resonant scattering of light from DNA and dark DNA occurs for the same frequencies.

Can one imagine remote transcription of dark DNA to ordinary DNA using *only nucleotides* as building bricks? This process would require coupling of DNA nucleotides to dark nucleons representing DNA triplets and it is not easy to imagine any simple mechanism making this possible. Already existing DNA triplets seem to be necessary.

3.3 Common Explanation For The Findings Of Montagnier And Gariaev

In the experiments of Montagnier's group [I9] the outcome is remote replication whereas the earlier experiments Gariaev's group [I6, I5] give evidence for phantom DNA and remote activation of DNA transcription by scattered laser light able to represented genetic code. There must be interaction between the test tubes in Montagnier's experiments and in the recent experiments of Gariaev's group observing remote replication there is explicit interaction between the test tubes due to the scattered laser radiation. Hence one expects a common underlying mechanism based on radiation between the tubes and phantom DNA.

1. The TGD based explanation [K5] of Montagnier's findings relies on the assumption that the homeopathic procedure generated a population of dark DNA nucleotides in the diluted system. The sequence of dilutions and shakings was like a series of environmental catastrophes driving the evolution of dark DNA and also feeding metabolic energy to the system. The outcome was dark DNA population mimicking the original DNA in the test tube B. In the presence of DNA polymerase in tube B and second test tube A containing ordinary DNA the dark DNA was somehow able to generate ordinary DNA in tube B. The detailed mechanism for this remained open.

2. Could the scattered laser light have the same effect as the homeopathic procedure? This would require a direct transcription of dark DNA to ordinary DNA in the presence of DNA polymerase and nucleotides (only them!). It is very difficult to understand how this could happen. DNA polymerase very probably does not have the same catalyzing effect on dark DNA sequences as on ordinary DNA sequences. It is also difficult to imagine the build-up of ordinary DNA from nucleotides using dark nucleon sequences as templates: if frequency coded codons would serve as building bricks, situation would be simpler as already found.

3. One must not forget that the presence of the test tube A was essential in the experiment of Montagnier: communications between the test tubes crucial for the outcome must have taken place. The consistency between the two experiments could be achieved if the DNA in test tube A generated the counterpart of the scattered laser signal in Gariaev's experiments but certainly as a much weaker signal.

4. This signal should have been amplified somehow by the presence the dark DNA sequences in tube B so that it would have been able to generate critical amounts of conjugate of the original DNA amplified by DNA polymerase to the copy of the original. What suggests itself is a positive feedback loop ordinary DNA sequences $\rightarrow$ dark DNA sequences $\rightarrow$ ordinary DNA sequences..... causing the amplification of the weak signal so that it is able to induce remote replication by the proposed mechanism. This kind of feedback of signals propagating between magnetic bodies was assumed also in the model for the strange images produced by the irradiation of DNA sample by ordinary light interpreted as photographs of magnetic flux tubes containing dark matter [K1].

This model explains also the findings of the recent experiment (unpublished) of Gariaev. In this case the amplification by feedback mechanism could be present but might not be needed since the scattered laser radiation could give strong enough signal to produce the needed amount of conjugate DNA serving as a template. What is nice from TGD point of view that the consistency between the two experiments gives support also for the notion of dark DNA and its identification as phantom DNA.

3.4 Summing Up The Basic Assumptions Of The Mechanism

The basic assumptions of the model of remote replication deserve a short summary.

1. Bio-molecules would serve as receiving and sending quantum antennas forming populations with communications between members just like higher organisms. The molecules participating the same reaction would naturally have same antenna frequencies. Quarks and antiquarks at the ends of the flux tubes would code for different nucleotides and the frequencies associated with the nucleotides would be identical. The character of classical electromagnetic field would code for a particular nucleotide.

2. Remote replication and other remote polymerization processes would differ from the ordinary one only in that the phase transition reducing the value of Planck constant for the flux tube would not take place and bring the molecules near each other. Note that the fractal hierarchy of flux quanta: nucleotide flux tubes, codon flux tubes and flux sheets associated with DNA strands is essential.

3. The immediate product of remote replication would be the conjugate of the original DNA sequence and DNA polymerase would amplify it to the copy of the original DNA sequence. This prediction could be tested by using very simple DNAs sequences- say sequences consisting two nucleotides which are not conjugates. For instance, one could check what happens if conjugate nucleotides are absent from the target (neither conjugate nor original DNA sequence should be produced). If the target contains conjugate nucleotides but no originals, only conjugate DNA sequences would be produced - one might hope in sufficiently large amounts to be detectable.

4. Frequency coding would be natural for quantum antenna interactions between ordinary DNA and its dark variant and also between dark variants of DNA, RNA, tRNA, and amino-acids. The reason is that dark nucleons represent the genetic code by entanglement and it is not possible to reduce the codon to a sequence of letters.

4 Possible Implications

The proposed realization of remote replication seems to have rather far reaching implications for the understanding of the mechanism of homeopathy and basic mechanisms of immune system as well as to the understanding of how DNA -dark nucleon sequence association. One can also interpret the proposed TGD based realization of the divisor code [K17] suggested by Khrennikov [K18] as frequency coding of DNA triplets by the value of Planck constant assignable to flux tubes emerging from DNA triplets.

4.1 Possible Relevance For Homeopathy And Immune System

TGD inspired vision about water memory assumes that the magnetic bodies of molecules dis-solved into water represent the molecules in terms of cyclotron frequencies characterizing its magnetic body. Molecules can lose their magnetic bodies as the hydrogen bonds connecting the molecule to the magnetic body are split. The population of these lost magnetic bodies would define a representation for the dissolved substance able to mimic it.

The hitherto unanswered questions concern the detailed structure of the magnetic body of the molecule and how it codes for the molecule. The hydrogen bonds connecting the molecule to the ordered water forming a kind of ice covering the molecule in the inactive state should be crucial aspect of the coding. If dark nucleon sequences are associated with the hydrogen bonds

of this "ice layer" or generated in their splitting as I have proposed, one can ask whether dark nucleon sequences could characterize the molecular magnetic body. If so, cyclotron resonance frequencies or more general frequencies associated with the dark DNA sequences could code for the molecule. DNA sequences would define a universal language allowing for the system to name for polar molecules.

Quantum antenna mechanism would in turn associate ordinary DNA sequences with the dark nucleon sequences coding for the molecule. Hence one can imagine a development of a mechanism allowing the organism to modify its DNA by adding to it genes coding for proteins characterized by the same resonance frequencies as the magnetic bodies of the invader molecules. These proteins would couple strongly to the invader molecules via quantum antenna mechanism and the phase transition reducing Planck constant would allow them to catch the invader molecules by attaching to them. The fact that the DNA of immune system evolves very rapidly conforms with this vision.

4.2 Frequency Coding For DNA Sequences By The Value Of Planck Constant As A Realization Of Divisor Code

The realization of dark magnetic bodies of polar molecules in terms of dark nucleon sequences allows to understand the association of dark DNA with ordinary DNA, RNA, and tRNA making among other things possible the transcription of dark DNA to DNA and vice versa. Dark nucleon sequences would be associated with the magnetic bodies of DNA, mRNA, and tRNA. This would apply also to amino-acid sequences. Dark DNA would separate from ordinary DNA as it loses its magnetic body in the splitting of hydrogen bonds and suffers denaturation. Similar mechanism would cause denaturation of other biomolecules and would mean that they "lose their names" and thus information content and become mere organic molecules instead of living bio-molecules. This kind of association would make the emergence of the genetic code and its generalization to the naming of molecules by DNA sequences trivial.

Genetic code can be understood from the proposed natural correspondence between dark nucleon sequences and DNA, RNA, tRNA, and acmino-acids). I have however developed also another realizaton based on TGD based realization of so called divisor code first suggested by Khrennikov and Nilsson [K18] and the following argument allows to interpret in terms of frequency for fixed value of photon energy with frequencies coded by the value of Planck constant.

1. The observation of Khrennikov and Nilsson is following. Consider the integers n in the range 1, ..., 21 and obviously labeling amino-acids and let $k(n)$ the number of divisors of n. Define $B(k)$ as the number of integers n for which the number of divisors is k. It turns out that the numbers $B(k)$ are rather near to the numbers $A(k)$ of amino-acids coded by k codons. This suggests that given amino-acid A is coded by a product of prime $p(A)$, which alone characterizes it, and integer $n(A)$ in the range $1, ..., 21$. The product of integers characterizing the codon coding for A would be characterized by the product of $p(A)$ and some factor $r(A)$ of $n(A)$. With these assumptions given codon would code for only single amino-acid and the number of DNAs coding for amino-acid A is the number of the factors $r(A)$ of $n(A)$. The codons coding for A would be coded by integers $p(A)r(A)$ such that $r(A)$ divides $n(A)$. The safest assumption would be that the primes $p(A)$ satisfy $p(A) > 19$ so that $p(A)$ does not divide $n(A)$ for any A. If $p(A)$ is as small as possible the value spectrum of $p(A)$ is

$$\{23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97, 101, 103, 107, 109\} \ .$$

If one assumes that the two additional amino-acids coded in some cases by non-vertebrate genetic code correspond to primes also the primes $113, 127$ are included.

What is interesting is that Mersenne prime $M_7 = 2^7 - 1 = 127$ appears in the model of genetic code based on the notion of Combinatorial Hierarchy [K4]. This model assumes that DNA codons correspond to 64 integers in the range $1, ..., 127$. This realization of the genetic code cannot however be consistent with the divisor code realized in the proposed manner since it would require that the integers $n(A)p(A)$ belong to the range $1, .., 127$. The prime factors of these integers can however belong to this range.

2. The TGD inspired proposal [K17] was that the flux tube assignable to amino-acid A corresponds to $\hbar = p(A) \times n(A)\hbar_0$ whereas the DNA triplet (for quark-antiquark coding nucleotide rather than triplet) coding for it is characterized by $\hbar = p(A) \times r(A)\hbar_0$ such that $r(A)$ divides $n(A)$.

3. This proposal could be interpreted in terms of frequency coding by quantum antenna mechanism. For a given photon energy E wave length would be coded by the value of $\hbar$ and one would have $\lambda_n = n\lambda_0$, $n = p(A)n(A)$ for amino-acids and $n = p(A)r(A)$ for codons. The condition that flux tube lengths are same for different DNA triplets would be satisfied if the common length of the flux tubes is an integer multiple of λ_0 proportional to the product of all integers appearing as factors in the integers coding for amino-acids. The common length of the flux tubes would be therefore proportional to the product $\prod_A p(A) \prod_A r_A$.

5 More Precise View About Remote DNA Replication

Both Luc Montagnier [I8, I9] and Peter Gariaev [I10] 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 [K19], who has developed the notion of wave DNA [I5] supported by Montagnier's findings.

Polymer chain reaction (PCR) [I1] 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 [I5, I11] DNA template would be remotely represented as what he calls wave DNA. Montagnier [I9] uses 7 Hz ELF radiation to obtain the effect whereas Gariaev [I10] 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 [K5].

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 [K19] 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.

5.1 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 [L5] 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.

5.1.1 Dark DNA as dark proton strings

TGD leads to a model of nuclei as nucleons strings [K15]. The model generalizes to the dark matter sector [K15, K5].

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 [K11].

   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 [I3, I4] suggest that invader molecules are indeed represented by the cyclotron frequency spectrum alone. This would suggest connection with wave DNA concept.

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

There are good empirical motivations [K16] 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.

5.1.3 Fourth phase of water, EZs, and metabolic role of cyclotron radiation

The experiments of Pollack [L5] 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 [L5] 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 [K14].

   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.

5.1.4 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 [K6] 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 [K6].

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 [I9] and Gariaev [K19]. 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}.

5.2 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 [K5] 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, K8].

   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.

6 Remote replication again

In TGD inspired vision about quantum biology relying on the notion of magnetic body (MB) carrying dark matter as phases of ordinary matter with effective Planck constant $h_{eff} = n \times h_0$ one ends up with the notion of dark DNA realized as sequences of dark protons and to the

surprising finding that dark proton triplets realize vertebrate genetic code and basic biomolecules DNA,RNA,tRNA, and amino-acids [L8, L11].

The objection against dark photon 3-chords (3-photon states) is that the simultaneous emission of 3 dark photons used in communications as 6-bit unit is extremely non-probable. A possible solution of the problem is that dark photons carry number theoretic color associated with Z_3 subgroup of Galois group. Number theoretic color confinement would imply that only 3-chords can appear as asymptotic states analogous to baryons. If dark protons are also number theoretic color triplet, dark codons must consists of 3 protons and therefore also ordinary codons have 3 letters.

The findings of Montagnier et al [I9] (`http://arxiv.org/abs/1012.5166`) raise the possibility of remote replication of DNA. Montangier's experiment involves two chambers A and B. A contained water and genes and B water and DNA nucleotides. There were channels between the chambers but so thin that DNA could not get through. Besides this there was present em field with 7 Hz frequency. Same genes as in A appeared also in B. As if remote replication of genes in A had happened in B. I have written an articles about Montagnier's findings [L1, L4]. Gariaev has reported similar phenomenon already before Montagnier et al: we wrote together an article discussing TGD based model for the finding [K19].

How did the genetic information pass to B and how the remote replication took place? Somehow the radiation made the remote metabolism possible or at least more probable. Clearly the information about gene - not only about codons but also about their order and relative positions - should have been communicated from A to B. I have already earlier considered this problem but found no satisfactory solution to it.

Concerning the role of the 7 Hz frequency, there are two hints.

1. The nominal value of the lowest Schumann frequency is 7.8 Hz, not far from 7 Hz. Could one think that macroscopic quantum coherence in the scale of Earth was involved. 7.8 Hz correspond to wavelength equal to circumference of Earth.

   "Endogenous" magnetic field $B_end = .2$ Gauss identifiable as the monopole flux part of the Earth's magnetic field $B_E = .5$ Gauss explains the findings of Blackman [**?**] and others about quantal looking effects of radiation at frequencies seem to be multiples of cyclotron frequencies of biologically important ions.

   The problem is that the energies of cyclotron photons are ridiculously small for ordinary value of Planck constant. This was one of the motivations for the hypothesis that dark matter corresponds to phases of ordinary matter with effective Planck constant $h_{eff} = n \times h_0$ [K11, K8, K9]. The cyclotron frequency of K ion is $f_c(K^+) = 7.1$ Hz. The flux tubes with length of corresponding cyclotron frequency are also of the order of Earth circumference.

This raises several questions.

1. Did water generate flux tubes with magnetic field with frequency equal to $f_c(K^+) = 7.1$ Hz and strengthening coupling to a radiation with Schumann frequency or K cyclotron frequency or both so that the communications with the MB of Earth or/and layer of MB corresponding to K cyclotron was strengthened? The TGD based mechanism of water memory [K5] would be involved.

2. Did this make the remote replication more probable? How?

3. What DNA actually looks like in TGD Universe? What actually happens in DNA replication? What could happen in remote DNA replication?

In the sequel the questions whether cyclotron frequency or Schumann frequency or both were involved and how their presence made possible remote replication remain without detailed answer although it is clear that the presence of dark photons with this frequency should make possible the control by MB generating coherence of ordinary matter in the scale determined by the sizes of the chambers. These questions however led to a considerable increase in the understanding of dark variants of genetic code predicted by TGD [L8, L3, L17].

1. To understand remote replication one must understand replication. Dark codons do not decompose into letters like chemical codons: this poses strong constraints on the replication

and transcription if one assumes DDNA-DNA-pairing. These constraints strongly suggests that the nucleotides in the water environment of DNA are not actually free but form loosely bound triplets representing codons and bound with DDNAs. This means a new variant of genetic code realizing codons as loose triplets of nucleotides in the water environment.

2. This proposal brings in mind TGD based model for viruses, which can decompose into pieces shared between several host cells and re-combine later as also the observation that the dense states of bacteria population have resemblance to multi-cellular embryos. The common TGD inspired explanation [L18] would be that the pieces of virus and cells of bacterial population are connected by magnetic flux tubes and form a single loosely bound unit at the level of MB. The prediction is that replication occurs in codon-wise manner: this has been observed to be possible for RNA [L13]. It might be that the loose nature of exotic DNA codons allows this to occur quite generally.

3. Remote replication in this framework reduces to ordinary replication in TGD sense if also dark genes are formed by attaching flux tubes characterizing dark codons to a long flux tube associated with gene. Remote replication requires that the portion of dark gene accompanying ordinary gene is transferred from chamber A to chamber B in the experiment of Montagnier.

6.1 Three variants of genetic code

The notions of MB and view about dark matter leads to 3 variants of genetic code.

1. The notion of MB suggests that dark proton sequences assumed to explain Pollack effect (`http://tinyurl.com/gwasd8o`) [L5] realize dark genetic code. Dark DNA (DDNA) codon would correspond to 3-proton triplet assignable to closed flux tubes attached to a a long flux tube by U-shaped flux tube appendix giving rise to dark gene (`http://tinyurl.com/jgfjlbe`). Attaching means formation of U-shaped appendices from long flux tube and DDNA codon which reconnect to a pair of flux tubes. 3-proton states define dark analogs of DNA, RNA, tRNA, and amino-acids (DDNA, DRNA, DtRNA, DAA) [L8, L11]. The numbers of DDNAs coding for given DAA are same as for vertebrate genetic code.

2. Second dark code is needed for communications and realizes genetic codons as dark 3-photon states - 3-chords of bio-harmony [L3, L16, L17] (`http://tinyurl.com/yad4tqwl`). The model emerged from a model of musical harmony based on icosahedron and tetrahedron. 12-note scale is identified as a Hamiltonian cycle - a path going through all 12 vertices of icosahedron - such that going from vertex to neighbor corresponds to quint. Hamiltonian cycles have cyclic group Z_n,where $n = 0, 2, 4, 6$ is the order of the group, as symmetries. $n = 0$ corresponds to chaotic orbit and disharmony. Each of the 20 faces - triangles - corresponds to a chord of given harmony.

   One identifies the orbit of given face as DAA coded by faces (DDNAs) at the orbit. By combining 3 harmonies with $n = 6$, $n = 4$ and $n = 2$ one obtains 20+20+20 chords and the numbers of DNA coding given AA are essentially those in vertebrate code. By gluing tetrahedron to one face one obtains 4 additional chords (DDNAs) and 1 additional note very near to one of the notes of Pythagorean scale, whose problem is that it does not quite close. The numbers for analogs of DNA codons coding for for given DAA are same as for vertebrate code.

   The chords would be represented as "music of light" as states of 3 dark photons. Music expresses and creates emotions and bio-harmony would provide a physical correlate for emotional states at molecular level [L14].

3. Dark codes would be fundamental and chemical code would be their mimicry. One expects DDNA-DNA pairing with DDNA codons represented as dark proton triplets. DDNA codons and dark photon chords have no decomposition to letters (chinese and western languages provide an analog). This suggests that DNA replication and transcription cannot take letter-wise but but codon-wise. Amazingly, there is evidence that DNA replicates in codon-wise manner during RNA era: I have commented this in [L13].

Nucleotides/letters in the water environment of DNA double strand should appear as loosely bound but correlated triplets of nucleotides associated with closed flux tubes containing dark DNA codon. They would represent exotic DNA codons. This would force fixed order of nucleotides essential for the code. By absence of valence bonds between nucleotides they would be effectively free but strongly correlated. This representation of the code would be crucial for replication and transcription.

These 3 codes allow to understand replication and transcription of DNA replaced in TGD with DDNA-DNA pair. The prediction is that the replication takes place codon by codon and might kill the model.

A model of replication based on this picture generalizes to remote replication suggested by the findings of Montagnier [I9]. The DDNA codons of ordinary DNA strand would be attached with a long side of closed flux tube as dark gene. In remote replication h_{eff} of dark gene would change and dark gene would be transferred to chamber B from A. After that the replication would proceed as usual.

6.2 An objection against bio-harmony

There is a serious objection against the realization of dark genetic code in terms of bio-harmony. The emission of 3 dark photons simultaneously looks extremely non-probable process.

Number theoretical physics suggests a solution of the problem. Number theoretical physics [L10] (`http://tinyurl.com/zylrd7w`) is a central part of quantum TGD and quantum biology and provides physical correlates for cognition. It explains dark matter as $h_{eff} = nh_0$ phases of ordinary matter with n identified as order of Galois group of extension of rationals and as dimension of extension. This picture predicts automatically evolution as increase of n in quantum jumps.

1. There is analogy with color confinement. Baryons consist of 3 quarks. Color symmetry is a symmetry of strong interactions and quarks form color triplets. Free quarks do not appear in the final states, which givs rise to color confinement: only color singlets, in particular baryons consisting of 3 quarks and mesons consisting of quark and antiquark are possible.

   This suggests that also now there must be a symmetry such that dark photons have new quantum numbers, which vanish for physical states such as dark photon triplets.

2. What these quantum numbers could be? The only candidate, which comes in mind are discrete quantum numbers related to the Galois group of extension of rationals defining number theoretic symmetry. For ordinary $h = 6h_0$ Galois group has $n = 6$ elements and equals to $Z_6 = Z_2 \times Z_3$.

   It appears as subgroup of higher Galois groups for which $h_{eff} = n \times h = 6nh_0$ one would have extension of extension. Z_3 confinement would require 3-photon states, which are Z_3 singlets with number theoretic colors summing up to zero. One would obtain only 3-chords. Ordinary photons would be Z_3 singlets.

3. Also the 3 protons of DDNA codon could form Z_3 triplet. Number theoretic color confinement would allow only 3-proton triplets. Genetic code is predicted correctly and the number letters in the codons is predicted to be 3.

This raises two interesting questions.

1. Quantum-classical correspondence (QCC) is a exact part of TGD. Therefore I have considered the possibility that all physical symmetries could have number theoretical space-time correlates. However, at space-time level one cannot have representations of color group with non-vanishing triality $t = 0, \pm 1$. Same applies to spin half-odd integer representations of rotation group. Could $SU(2) \times SU(3)$ representations with triality $t = \pm 1$ and spin half-odd integer have triplet representation of Z_3 and double representation of Z_2 as space-time correlates? Z_6 would be the minimal Galois group allowing to realize spin and color for quarks.

2. Number theoretical physics predicts that Galois group for any extension of rationals acts as new hidden discrete symmetry. Could number theoretical confinement implying new selection rules be true quite generally? The larger the degree n of extension (h_eff), the larger the scale in which confinement holds true, is. For instance, genes could be analogs of color singlet many particle states for a larger subgroup.

This is not the only option. I have already earlier considered with Peter Gariaev [K19] a proposal in which dark photons would communicate the genetic information from A to B. The problem is how the massless extremals (MEs) [K12] associated with them can be parallel and of same length: this would require that they form a quantum coherent entity. Could one consider a modification of the above proposal assuming that gene is an entity of N codons confined number theoretically? Could one can speak about dark photon genes as composites of N dark photon 3-chords? The information would be sent by dark photon gene representing entire music piece, as one might say. In chamber B energy-frequency resonance would generate a linear configuration of exotic codons, which would reduce to DDNA-DNA pair when h_{eff} is reduced.

6.3 DDNA-DNA, DDNA-DDNA, DDNA-exotic DNA pairings

The idea about MB as boss of BB suggests that DNA is accompanied by DDNA. DDNA would be the fundamental DNA and ordinary DNA emerged later as a kind of mimicry and there would be DDNA-DNA pairing.

The basic problem problem is that DDNA codons do not allow decomposition into letters like DNA codons. It seems that replication and transcription must occur codon by codon rather than letter by letter. For translation of mRNA this is indeed the case: tRNA are the basic objects. Could this be true in modified sense also for replication and transcription? In fact, RNA can replicate in codon-wise manner [L13]. Could this occur quite generally, and could the codons for replication believed to occur letter-wise be present in a latent manner?

6.3.1 DNA and DDNA codons

At least 3 new kind of codons are predicted (`http://tinyurl.com/yygqen5g`).

1. Also ordinary DNA codons involve flux tubes. Valence bonds between nucleotides of DNA strand and hydrogen bonds in double strand involve flux tubes or pairs of them.

2. DDNA codons are paired with ordinary DNA codons of DNA strand. DDNA codons would correspond to dark proton triplets at flux loops being analogous to tritium and ^{3}He. The model for remote replication requires that DDNA codon loops are connected to long closed dark gene flux loop by U-shaped appendages - attached to dark gene.

   If DDNA and DNA codons are paired with ordinary DNA by energy resonance there is no need for flux tube contacts between the triplets.

3. Dark codons as dark photon 3-chords are predicted. Couple to DDNA by energy-frequency resonance and to DNA by energy-resonance.

4. Exotic DNA codons are required by the model of replication. DNA nucleotides in environment would combine to exotic codons paired with DDNA codons.

6.3.2 What various pairings do look like?

There would be 3 kinds of pairings. This would predict that nucleotides appear as apparently free entities in the water environment.

1. DDNA-DNA pairing in DNA strand. Different values of h_{eff} do not allow flux tubes contacts. Energy resonance only.

2. DDNA-DDNA pairing in DNA double strand is not necessary in geometric sense as flux tube connections because hydrogen bonds pair DNA codons and energy resonance pairs DDNA strands to DNA codons. DDNA codons could be however located along dark gene flux tube and attached to it by flux tube pairs.

3. DDNA-exotic DNA pairing would take place in environment. Nucleotides of exotic DNA would be attached to closed DDNA codon flux tubes. h_{eff} would be larger than for DDNA codon in double strand. There would be no valence bonds between nucleotides. The ordering of letters would be forced by flux tube containing the dark codon and energy resonance. One obtains correct codon if the orientation of the flux tube matters (ABC and BCA correspond to different energies in energy resonance). Strong parity breaking allowed by TGD and realized in living matter would imply it.

   This would solve the basic problem. Codon would be secretly present since there would be no valence bonds, which together with small string tension would mean that nucleotides are effectively free.

4. It is of course not clear whether this is enough to explain experimental findings. If one can demonstrate experimentally that the build-up of DNA strand in replication really occurs in letter-wise manner, the proposed model must be modified (not of course clear whether this is possible). The codon-wise coding, which can occur for RNA [L13] could be understood if the value of h_{eff} for DRNA strand can be same or nearly the same as in RNA strand.

6.4 Did RNA replicate in codon-wise manner during RNA era?

There was an interesting popular article in Spacedaily with title "*Scientists crack how primordial life on Earth might have replicated itself*" (see `http://tinyurl.com/y92ng5vd`). The research paper [I7] is titled "*Ribozyme-catalysed RNA synthesis using triplet building blocks*" and published in eLife (see `http://tinyurl.com/ya5qyjfn`).

It is possible to replicate unfolded RNA strands in Lab by using enzymes known as ribozymes, which are RNA counterparts of enzymes, which are amino-adic sequences. In the presence of folding the replication is however impossible. Since ribozymes are in general folded, they cannot thus catalyze their own replication in this manner. The researchers however discovered that the replication using RNA triplets - genetic codons - as basic unit can be carried out in laboratory even for the folded RNA strands and with rather low error rate. Also the ribozyme involved can thus replicate in codon-wise manner. For units longer than 3 nucleotides the replication becomes prone to errors.

These findings are highly interesting in TGD framework. In TGD the chemical realization of genetic code is not fundamental. Rather, dark matter level would provide the fundamental realizations of analogs of DNA, RNA, tRNA, and amino-acids as dark proton sequences giving rise to dark nuclei at magnetic flux tubes [L11] (see `http://tinyurl.com/yalny39x`). Also ordinary nuclei correspond in TGD Universe to sequences of protons and neutrons forming string like entities assignable to magnetic flux tubes.

The basic unit representing DNA, RNA and tRNA codon and amino-acid would consist of 3 entangled dark protons. The essential aspect is that by entanglement the dark codons do not decompose to products of letters. This is like words of some languages, which do not allow decomposition to letters. This representation is holistic. As we learn to read and write, we learn the more analytic western view about words as letter sequences. Could the same hold true in evolution so that RNA triplets would have come first as entities pairing with dark RNA codons from from dark proton triplets as a whole? Later DNA codons would have emerged and paired with dark DNA codons. Now the coupling would have have been letter by letter in DNA replication and transcription to mRNA.

It is intriguing that tRNA consists of RNA triplets combined from amino-acids and analogs of mRNA triplets! The translation of mRNA to amino-acids having no 3-letter decomposition alone forces the holistic view but one can ask whether something deeper is involved. This might be the case. I have been wondering whether during RNA era RNA replicated using a prebiotic form of translational machinery, which replicated mRNA rather than translated RNA to protein formed from amino-acids (AAs) with AA serving as a catalyst.

1. During RNA era amino-acids associated with pre-tRNA molecules would served as catalysts for replication of RNA codons. The linguistic mode would have been "holistic" during RNA era in accordance with the findings of the above experiments. RNA codon would have been the basic unit.

2. This would have led to a smaller number of RNAs since RNA and RNA like molecules in tRNA are not in 1-1 correspondence. A more realistic option could have been replication of subset of RNA molecules appearing in tRNA in this manner.

3. Then a great evolutionary leap leading from RNA era to DNA era would have occurred. AA catalyzed replication of RNA would have transformed to a translation of RNA to proteins and the roles of RNA and AA in tRNA would have changed. [Perhaps the increase of h_{eff} in some relevant structure as quantum criticality was reached led to the revolution]

4. At this step also (subset of) DNA and its transcription to (a subset of) mRNA corresponding to tRNA had to emerge to produce mRNA in transcription. In the recent biology DNA replicates and is transcribed nucleotide by nucleotide rather than using codon as a unit so that helicases and DNA and RNA polymerases catalyzing replication and transcription should have emerged at this step. The ability of DNA to unwind with the help of helicase enzyme helping DNA to unwind is essential for the transcription and translation of DNA. Therefore helicase must have emerged together with the "analytic linguistic mode" as an analog of written language (DNA) decomposing codons to triplets of letters. This would been a crucial step in evolution comparable to the emergence of written language based on letters. Also the counterpart of RNA polymerase and separate RNA nucleotides for transcription should have emerged if not already present.

   An alternative option would involve "tDNA" as the analog of tRNA and the emergence of helicase and polymerases later as the transition from holistic to analytic mode took place.

   The minimal picture would be emergence of a subset of DNA codons corresponding to RNAs associated with pre-tRNA and the emergence of the analogs of helicase and DNA and RNA polymerases as the roles of amino-acid and RNA codon in tRNA were changed.

5. How DNA could have emerged from RNA? The chemical change would have been essentially the replacement of ribose with de-oxiribose to get DNA from RNA and U$\rightarrow$ T. Single O-H in ribose was replaced with H. O forms hydrogen bonds with water and this had to change the hydrogen bonding characteristics of RNA.

   If the change of $h_{eff} = n \times h_0$ was involved, could it have led to stabilization of DNA? Did cell membrane emerge and allow to achieve this? I have proposed [L11] (see `http://tinyurl.com/yalny39x`) that the emergence of cell membrane meant the emergence of new representation of dark genetic code based on dark nuclei with larger value of h_{eff}.

   Remark: One has $h = 6 \times h_0$ in the most plausible scenario [L9, L12] (see `http://tinyurl.com/goruuzm` and `http://tinyurl.com/y9jxyjns`).

The communication between dark and ordinary variants of biomolecules involves resonance mechanism and would also involve genetic code represented as 3-chords, music of light, and it is interesting to see whether this model provides additional insights.

1. The proposal is that 3-chords assignable to nucleotides as music of light with allowed 64 chords defining what I have called bio-harmony is essential for the resonance [L14, L15, L12](see `http://tinyurl.com/ydhxen4g`, `http://tinyurl.com/yd5t82gq`, and `http://tinyurl.com/y9jxyjns`). The 3 frequencies must be identical in the resonance: this is like turning 3 knobs in radio. This 3-fold resonance would correspond to the analytic mode. The second mode could be holistic in the sense that it would involve only the sum only the sum of the 3 frequencies modulo octave equivalence assigning a melody to a sequence of 3-chords.

2. The proposal is that amino-acids having no triplet decomposition are holistic and couple to the sum of 3 frequencies assignable to tRNA and mRNA in this manner. Also the RNAs in tRNA could couple to mRNA in this manner. One could perhaps say that tRNA, mRNA and amino-acids codons sing whereas DNA provides the accompaniment proceeding as 3-chords. The couplings of DNA nucleotides to RNA nucleotides would rely on the frequencies assignable to nucleotides.

3. If the sum of any 3 frequencies associated with mRNA codons is not the same except when the codons code for the same amino-acids, the representation of 3-chords with the sum of

the notes is faithful. The frequencies to DNA and RNA nucleotides cannot be however independent of codons since the codons differing only by a permutation of letters would correspond to the same frequency and therefore code for the same amino-acid. Hence the information about the entire codon would be needed also in transcription and translation and could be provided either by dark DNA strand associated with DNA strand or by the interactions between the nucleotides of the DNA codon.

4. The DNA codon itself would know that it is associated with dark codon and the frequencies assignable to nucleotides could be determined by the dark DNA codon. It would be enough that the frequency of the letter depends on its position in the codon so that there would be 3 frequencies for every letter: 12 frequencies altogether.

   What puts bells ringing is that this the number of notes in 12-note scale for which the model of bio-harmony [L3, L14] (see `http://tinyurl.com/yad4tqwl` and `http://tinyurl.com/ydhxen4g`) based on the fusion of icosahedral (12 vertices and 20 triangular faces) and tetrahedral geometries by gluing icosahedron and tetrahedron along one face, provides a model as Hamiltonian cycle and produces genetic code as a by-product. Different Hamiltonian cycles define different harmonies identified as correlates for molecular moods.

   Does each DNA nucleotide respond to 3 different frequencies coding for its position in the codon and do the 4 nucleotides give rise to the 12 notes of 12-note scale? There are many choices for the triplets but a good guess is that the intervals between the notes of triplet are same and that fourth note added to the triplet would be the first one to realize octave equivalence. This gives uniquely $CEG\sharp$, $C\sharp FA$,$DF\sharp B\flat$, and $DG\sharp B$ as the triplets assignable to the nucleotides. The emergence of 12-note scale in this manner would be a new element in the model of bio-harmony.

   There are 4!=24 options for the correspondence between $\{A,T,C,G\}$ as the first letter and $\{C,C\sharp,D,D\sharp\}$. One can reduce this number by a simple argument.

   (a) Letters and their conjugates form pyrimidine-purine pairs T,A and C,G. The square of conjugation is identity transformation. The replacement of note with note defining at distance of half-octave satisfies this condition (half-octave - tritonus - was a cursed interval in ancient music and the sound of ambulance realizes it). Conjugation could correspond to a transformation of 3-chords defined as

   $$CEG\sharp \leftrightarrow DF\sharp B\flat \ , \quad C\sharp FA \leftrightarrow D\sharp GB \ .$$

   (b) One could have

   $$\{T,C\} \leftrightarrow \{CEG\sharp, C\sharp FA\} \ , \quad \{A,G\} \leftrightarrow \{DF\sharp B\flat, D\sharp GB\} \ ,$$
   $$\text{or}$$
   $$\{T,C\} \leftrightarrow \{DF\sharp B\flat, D\sharp GB\} \ , \quad \{A,G\} \leftrightarrow \{CEG\sharp, C\sharp FA\} \ .$$

   .

   (c) One can permute T and C and A and G in these correspondences. This leaves 8 alternative options. Fixing the order of the image of (T,C) to say $(C,C\sharp)$ fixes the order of the image of (A,G) to $(D,D\sharp)$ by the half-octave conjugation. This leaves 4 choices. Given the bio-harmony and having chosen one of these 4 options one could therefore check what given DNA sequence sounds as a sequence of 3-chords [L3].

   That the position the frequency associated with the nucleotide depends on its position in the codon would also reflect the biochemistry of the codon and this kind of dependence would be natural. In particular, different frequencies associated with the first and third codon would reflect the parity breaking defining orientation for DNA.

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