Bio-catalysis, morphogenesis by generalized Chladni mechanism, and bio-harmonies

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Abstract

In this article I try to relate 3 different ideas inspired by TGD.

1. The first idea is that bio-catalysis relies on the notion of magnetic body carrying dark matter: reconnections of flux tubes and the reduction of their lengths as the value of $h_{eff}/h = n$ is reduced play a key role. The reduction of $h_{eff}/h = n$ liberates also energy associated with hydrogen atom like states at flux tubes: this energy could allow the reactants to overcome the potential wall making the otherwise very slow reaction fast.
2. Second idea is that generalized Chladni mechanism is behind morphogenesis and therefore also involved with catalysis. Charged particles and even charged flux tubes would end up to the nodal surface of electric field to form biological structures.
3. The third idea is that genetic code is realized as 3-chords of what I call bio-harmony and represented as dark photon triplets and "massless extremals" or topological light rays. Could the sequence of 3-chords provide a basic realization of Chladni mechanism so that morphogenesis would be "music of blood" (Greg Bear has written a fascinating scifi book with this title).

Contents

1 Introduction

In the following I try to relate 3 different ideas inspired by TGD.

1. The first idea is that bio-catalysis relies on the notion of magnetic body (MB) carrying dark matter: reconnections of U-shaped flux tubes giving rise to super-conducting flux tube pairs connecting two systems, and the reduction of their lengths as the value of $h_{eff}/h = n$ is reduced play a key role. The reduction of $h_{eff}/h = n$ for dark atom liberates also energy associated with hydrogen atom like states at flux tubes with energy scaling as $1/h_{eff}^2$. This energy could allow the reactants to overcome the potential wall making the otherwise very slow reaction fast [L4].

   This idea emerged from a model for hydrino atoms proposed by Randell Mills [D1] having scaled up binding energy spectrum manifesting itself as a radiation band in EUV range

having no chemical origin. The simplest explanation TGD explanation is that the value of $h_{eff}/h = n$ is $n = 6$ for visible matter and that for hydrino like states it is $m = 1, 2, 3$. This would predict the scaling of the energy spectrum by $(n/m)^2$ and its occurrence would liberate the excess binding energy to be used by reacting molecules.

2. Second idea is that generalized Chladni mechanism [L5] is behind morphogenesis and therefore very probably involved also with catalysis. Charged particles and even charged flux tubes would end up to the nodal surface of electric field to form biological structures. One could speak about dynamics of avoidance and the particles ending up to potential minima provide one example of this dynamics.

   In fact, there are strong mathematical and physical reasons to argue that the dynamics of space-time surface is dynamics of avoidance [L3]. The preferred extremals for the sum of Kähler action and volume term are extremals of both so that one can say that force density defined by Kähler action vanishes and the motion corresponds to a generalization of geodesic line to 4-D minimal surface.

3. The third idea is that genetic code is realized as 3-chords of what I call bio-harmony and represented as dark photon triplets and "massless extremals" (MEs) or "topological light rays" [L1]. This gives also rise to a realization as sounds since living matter consists of electrets transforming light to sound and vice versa. The question is whether the sequence of 3-chords representing gene could provide a basic realization of Chladni mechanism so that morphogenesis could be regarded as "music of blood" (Greg Bear has written a fascinating scifi book with this title).

2 Catalysis and morphogenesis

I have ended up to a rather general mechanism of catalysis in terms of generalized Chladni mechanism [L5]. The idea is that one has superposition of say em waves and charged particles enter to the surfaces at which electric force vanish. If magnetic forces is parallel to the surface, they state at the surface. If the interfering waves have same frequency the situation is stationary. Also slowly varying frequency can be allowed if the the frequency is small as compared to the time scale of the re-organization of charged particles to the nodal surface of electric field.

In TGD framework the superposition of fields is replaced with superposition of corresponding classical forces on charged particles. MEs are carriers of the counterparts of classical fields and one can have analogs of standing waves as MEs carrying the analog of plane wave having fixed frequency. Charged particle in region of $H = M^4 \times CP_2$ containing disjoint union of MEs of this kind touches all MEs and experiences the sum of the forces created by the fields at MEs. Charged particles could be also replaced by magnetic flux tubes carrying charge particles. Using pairs of MEs for which waves propagate in opposite directions one obtains effective standing waves and one can form disjoint unions of these pairs in the same many to obtain more complex nodal surfaces.

Biochemical reactions are central for morphogenesis at molecular level. The general TGD based vision is that MB containing dark matter controls biochemistry. This would explain why biochemical reactions can occur coherently in the scale of cell or even longer scales. One can even ask whether the fundamental dynamics is that of MBs and MEs representing TGD counterparts of radiation fields and whether MB in 4-D sense serves as a template for the biochemical self-organization patters. The question is whether the generalized Chladni mechanism for MEs [K3] could play a role in bio-catalysis.

2.1 Conditions on bio-catalysis

Bio-catalysis is key mechanism of biology and its extreme efficacy remains to be understood. Enzymes are proteins and ribozymes RNA sequences acting as biocatalysts.

What catalysis demands?

1. Catalyst and reactants must find each other. How this could happen is very difficult to understand in standard biochemistry in which living matter is seen as soup of biomolecules. I have already already considered the mechanisms making it possible for the reactants to

find each other. For instance, in the translation of mRNA to protein tRNA molecules must find their way to mRNA at ribosome. The proposal is that reconnection allowing U-shaped magnetic flux tubes to reconnect to a pair of flux tube connecting mRNA and tRNA molecule and reduction of the value of $h_{eff} = n \times h$ inducing reduction of the length of magnetic flux tube takes care of this step. This applies also to DNA transcription and DNA replication and bio-chemical reactions in general.

2. Catalyst must provide energy for the reactants (their number is typically two) to overcome the potential wall making the reaction rate very slow for energies around thermal energy. The TGD based model for the hydrino atom having larger binding energy than hydrogen atom claimed by Randell Mills [D1] suggests a solution [L4]. Some hydrogen atom in catalyst goes from (dark) hydrogen atom state to hydrino state (state with smaller h_{eff}/h and liberates the excess binding energy kicking the either reactant over the potential wall so that reaction can process. After the reaction the catalyst returns to the normal state and absorbs the binding energy.

3. In the reaction volume catalyst and reactants must be guided to correct places. The simplest model of catalysis relies on lock-and-key mechanism. The generalized Chladni mechanism forcing the reactants to a two-dimensional closed nodal surface is a natural candidate to consider. There are also additional conditions. For instance, the reactants must have correct orientation. For instance, the reactants must have correct orientation and this could be forced by the interaction with the em field of ME involved with Chladni mechanism.

4. One must have also a coherence of chemical reactions meaning that the reaction can occur in a large volume - say in different cell interiors - simultaneously. Here MB would induce the coherence by using MEs. Chladni mechanism might explain this if there is there is interference of forces caused by periodic standing waves themselves represented as pairs of MEs.

2.2 Phase transition reducing the value of $h_{eff}/h = n$ as a basic step in bio-catalysis

Hydrogen atom allows also large $h_{eff}/h = n$ variants with $n > 6$ with the scale of energy spectrum behaving as $(6/n)^2$ if the $n = 4$ holds true for visible matter. The reduction of n as the flux tube contracts would reduce n and liberate binding energy, which could be used to promote the catalysis.

The notion of high energy phosphate bond is somewhat mysterious concept and manifests as the ability provide energy in ATP to ADP transition. There are claims that there is no such bond. I have spent considerable amount of time to ponder this problem. Could phosphate contain (dark) hydrogen atom able to go to the a state with a smaller value of h_{eff}/h¡ and liberate the excess binding energy? Could the phosphorylation of acceptor molecule transfer this dark atom associated with the phosphate of ATP to the acceptor molecule? Could the mysterious high energy phosphate bond correspond to the dark atom state. Metabolic energy would be needed to transform ADP to ATP and would generate dark atom.

Could solar light kick atoms into dark states and in this manner store metabolic energy? Could nutrients carry these dark atoms? Could this energy be liberated as the dark atoms return to ordinary states and be used to drive protons against potential gradient through ATP synthase analogous to a turbine of a power plant transforming ADP to ATP and reproducing the dark atom and thus the "high energy phosphate bond" in ATP? Can one see metabolism as transfer of dark atoms? Could possible negentropic entanglement disappear and emerge again after ADP$\rightarrow$ ATP.

Here it is essential that the energies of the hydrogen atom depend on $\hbar_{eff} = n \times h$ in as $\hbar_{eff}^m$, $m = -2 < 0$. Hydrogen atoms in dimension D have Coulomb potential behaving as $1/r^{D-2}$ from Gauss law and the Schrödinger equation predicts for $D \neq 4$ that the energies satisfy $E_n \propto (h_{eff}/h)^m$, $m = 2 + 4/(D-4)$. For $D = 4$ the formula breaks since in this case the dependence on $\hbar$ is not given by power law. m is negative only for $D = 3$ and one has $m = -2$. There $D = 3$ would be unique dimension in allowing the hydrino-like states making possible bio-catalysis and life in the proposed scenario.

It is also essential that the flux tubes are radial flux tubes in the Coulomb field of charged particle. This makes sense in many-sheeted space-time: electrons would be associated with a pair formed by flux tube and 3-D atom so that only part of electric flux would interact with the electron touching both space-time sheets. This would give the analog of Schrödinger equation in Coulomb potential restricted to the interior of the flux tube. The dimensional analysis for the 1-D Schrödinger equation with Coulomb potential would give also in this case $1/n^2$ dependence. Same applies to states localized to 2-D sheets with charged ion in the center. This kind of states bring in mind Rydberg states of ordinary atom with large value of n.

The condition that the dark binding energy is above the thermal energy gives a condition on the value of $h_{eff}/h = n$ as $n \leq 32$. The size scale of the dark largest allowed dark atom would be about 100 nm, 10 times the thickness of the cell membrane.

3 The notion of bio-harmony and morphogenesis as music

For few years ago I constructed a model for harmony in music [L1] [K2]. The idea was that Pythagorean 12-note scale is represented as closed non-self-intersecting curve at icosahedron having 12 vertices and 20 face triangles with subsequent points of curve being nearest neighbors such that the frequencies for them differ by a scaling factor 3/2. This gives slightly more than 7 octaves giving rise to the discrepancy already well-known for Pythagoras. The frequencies were projected to the basic octave by octave equivalence to get 12-note scale.

These closed curves at icosahedron related by icosahedral symmetry are equivalent and one obtains finite number of non-equivalent curves known as Hamiltonian cycles. Only cycles having symmetries were considered. Each would define a harmony with 20 basic 3-chords assignable to the triangular faces of icosahedron. Hamiltonian cycles are classified by their symmetries: symmetry group can be maximal Z_6, Z_4, or Z_2 which can correspond to π rotation or reflection.

The connection with genetic code came as a total surprise.

1. Icosahedron has 20 faces and this led to the question whether they could correspond to the 20 amino-acids. The observation was that 60=20+20+20 DNAs could be interpreted in terms of icosahedral harmonies corresponding to 3 Hamiltonian cycles with symmetry groups Z_6, Z_4 and Z_2. This gives 256 different bio-harmonies.

2. What about missing 4 DNAs? There are also two amino-acids (Pyl and Sec), which are appear in Nature and are coded by a variant of genetic code. Should one add tetrahedron in order to obtain the additional codons and amino-acids and two variants of the code. Also the failure to obtain exactly 7 octaves can be used to argue that one must add tetrahedron as glued to one side of icosahedron. This would give one additional note corresponding to the note going slightly out of the octave scale. The outcome is indeed two slightly different variants of the genetic code. What is so remarkable that the model predicts correctly the numbers of codons coding for a given amino-acid.

How to realize bioharmonies?

1. The proposal was that genetic code is realized as sequences of 3-chords represented in terms of dark photons with frequency ratios determined by the given bio-harmony. Since dark photons can transform to ordinary photons identified as bio-photons, also interaction with visible matter would be possible. The transformation to ordinary sounds is also possible that the connection with music would be very concrete.

2. The dark photons would couple to dark variants of genes proposed to be realized as dark proton sequences [L2]. Remarkably, also this realization of the genetic code predicts the numbers of codons coding for a given amino-acid correctly. If the notes of the 12-note scale correspond to the cyclotron frequencies assignable to the dark protons, the two realizations would be connected. For dark proton the cyclotron frequency in the endogenous magnetic field of .2 Gauss is 300 Hz so that the "music of blood" would be in the same frequency range as ordinary music. The notes of the scale would correspond to a spectrum of magnetic field strengths as indeed assumed for bio-photons. Large value of $h_{eff} = h_{gr}$ would guarantee that energies are in the range of bio-photon energies and are biologically effective.

3. Musical harmonies would be central in biology and the essence of what it is to be living. The functioning organism is very literally like an orchestra. Various disorders would be analogous to dissonances. There are 256 different harmonies and same DNA sequence could correspond to any of these harmonies. Music is expression of emotions and generates emotions. The natural proposal is that these harmonies provide the molecular realization of emotions and basic building bricks of also our our emotions.

4. This would give rise to a kind of resonance based communication and control system used by MB. For instance, the translation of mRNA sequence to amino-acid sequence would be like playing a piece of music. tRNAs attaching to given mRNA codon would correspond to the same 3-chord. Also amino-acids would correspond to dark DNA codons (dark protons in various states) and corresponding cyclotron frequencies.

This picture provides a different view about genetics. The reductionistic interpretation is that given gene corresponds to a given trait and enormous amount of work is done to deduce correlations between traits and genes. This picture has been challenged. It seems that the reductionism to single gene level simply does not make sense. If it would, it should be possible to predict given trait given gene corresponds: this kind of formula is extremely unfeasible. One must consider the entire genome.

The ability of the collection of genomes to play together to produce music of life would be essential. Disorders would be deviations from harmony and would be also caused by genetic mutations. Already earlier I ended up to a generalization of the notion of genome inspired by the notion of MB. The flux sheets of the MB would go through the DNA and could integrate the genomes of different cells to single coherent whole. One would have hierarchy: coherent gene expression in the scale of organism and even entire population would become possible using collective genome controlled by MB would become possible.

Here a connection with TGD inspired model of morphogenesis [L5] suggests itself strongly. Topological light rays (NEs) are correlates for communications between MB and biological body involving control by MB and sensory input from biological body and EEG is one example ab out these communications.

This inspires a model of morphogenesis based on generalized Chladni mechanism meaning that charged particles or even charged magnetic flux tubes are driven to the nodal surfaces of electric fields representing standing waves. The standing wave are represented as pairs of MEs with opposite direction of momentum (analogs of planewaves). The charged article experiences the sum of the forces assignable to various fields at various space-time sheets so that effectively the fields superpose. Nodal surfaces would correspond to nodal surfaces of this effective field.

The 3-chord sequences could play a crucial in morphogenesis and morphostasis. Since the frequencies of the chord are in general different, the fields representing the members of the code cannot define static nodal surfaces. Hence given 3-chord could define a region of 3-space as union of 3 nodal surfaces. In the case of DNA they would correspond to the 3 letters of the codon. Note that dark codons themselves correspond to the states of dark proton mapped to frequency triplets and do not allow this kind of decomposition.

4 About Chladni mechanism, bio-harmonies, and genetic code for morphology

I have proposed that generalized Chladni mechanism plays a key role in morphogenesis and morphostasis [L5]. Since the nodal surfaces of field patterns define the shape of structures one can wonder whether Chladni mechanism realies on 3-chords of bio-harmonies. Could morphogenesis express the music based on bioharmonies? On can consider this idea in more detail.

1. Single ME allows only waves propagating with light velocity and standing waves are impossible. For a pair of MEs carrying analogs of plane waves with opposite spatial directions and same frequency, the nodes at which the em force experienced by charge particle vanishes, correspond to the vanishing of $sin(\omega t)sin(kz)$ at $z = n\pi/k$. Cladni surface is 1-D lattice formed by 2-D cross sections of ME.

2. A region of M^4, where several ME pairs with the same frequency have a non-empty projection, represents an analog of hologram. Now the nodal surfaces correspond to the vanishing of the sum for the electric fields associated with MEs. For single ME there is one condition to be satisfied but for several (at least two) MEs meeting at same region of plane there are two conditions and they allow as a solution 1-D surface in the region where MEs meet. For more than 2 ME pairs, which are not in plane, the nodal surface consists of points.

   If MEs are parallel with magnetic flux tubes the charged particles represented as wormhole contacts connecting ME and flux tube goes to the nodes $z = n\pi/k$. If there are 3 MEs (not in plane) for which the intersection or M^4 projections corresponds to a nodal surface of each then the nodal surface for all of them consists of single point in the intersection.

   The localization to single point might be too strong a condition. Rather, 1-D localization of charges inside flux tubes form a network of flux tubes with nodes at the nodes for all flux tubes that meet might be enough. In this case the frequencies assignable to the flux tubes need not be identical. TGD based model for musical harmony relying on icosahedral and tetrahedral geometries leads also to model for genetic code and suggests strongly the realization of genetic code in terms of 3-chords. The notes of the chord would correspond to 3 different nodal surfaces assignable to DNA nucleotides for instance.

3. With motivations coming from biology I have proposed that magnetic flux tubes and MEs parallel to them form lattice like structures with MEs and flux tubes defining the coordinate lines of a coordinate grid. For plane wave MEs with same frequency in these directions the nodal points are at the nodes of the grid and one obtains a lattice like structure. Also icosahedral quasicrystals can be considered.

   There are good reasons to expect that also curvilinear MEs with the directions of wave vector and polarization vector depending on the position along ME. This would allow also quasi-lattices, which could be important in biology. Chladni mechanism for these structures could allow to catalyze chemical reaction in the nodes of the lattice and achieve the mysterious looking large scale coherence of biochemical reactions. Quasi-lattice could correspond also to the tissue formed by cells, to lipid layer of cell membrane, or to DNA or protein as 1-D lattice.

Consider now the possible connection between genetic code and the geometry of the 3-D lattice like structure.

1. I have also proposed that through each DNA codon there goes 3 approximately orthogonal flux tubes - one tube per nucleotide - connecting it to some other molecules. One flux tube would be roughly parallel to DNA and two orthogonal to it. The molecules associated with the nodes could be other DNA nucleotides. There are many options to consider. The nucleotide of second DNA strand and the corresponding nucleotide in the DNA of second cell can be considered. The genomes of different cells could form a 3-D lattice with lattice points represented by DNAs and flux tube connections between corresponding DNA codon. The model for DNA-cell membrane system as topological quantum computer [K1] leads to ask whether DNA codons not involved with the coding of proteins could be connected with lipids of the lipid layer and define braids essential for topological quantum computation. Now the flux tube pair could be also associated with entire codon.

   Could the number 3 for DNA nucleotides correspond to the dimension of the quasi-lattice involved? Could the flux tubes in three approximately orthogonal directions go through the three nucleotides and connect them to the corresponding DNA nucleotide in another cell? Could this correspondence preserve the linear order or can one imagine braiding but requiring that nucleotide is connected to its conjugate always as in DNA double strand?

   This correspondence would give a profound geometric meaning for the number of letters of DNA codon. Only 1-D localization at the vertices of the flux tube is possible. The orientation of molecules entering to the node along 3 flux tubes (also essential for the catalyst action) could be interpreted as catalyst and the orientation of the catalyst and reacting molecules could be determined to a high degree by the interaction with em fields of the flux tube.

2. The lattice constants for the flux tubes connecting nucleotides in different cells should be same but in the simplest picture they would be given by $d_i = a_i = c/\omega_i$. One should require $d = n_i a_i = n_i c/\omega_i$. If the frequencies are in rational ratios as for Pythagorean scale the integers can be chosen in this manner. The number n_i of nodes along ME between different cells proportional to ω_i would code for the frequency geometrically. The special emotional role of Pythagorean scale could reduce to a geometric condition, whose failure would tend to deform DNA!

3. The possibility to have different frequencies for different flux tubes and the fact that the lattice constant defined by the wavelength is given by $a_i = n_i c/\omega$ means that the DNAs of different cells form an orchestra with music consisting of dark photons possibly being able to transform to dark phonons by piezo-electricity. The frequency scale should correspond to the inverse of the cellular distance. It is to be expected that also shorter scales corresponding to UV frequencies in bio-photon spectrum are involved.

To sum up, this picture would mean a long sought for direct connection between genes and the morphology of organism determined by the quasi-lattice like structure.

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