An attempt to understand the findings of Elia et al about chiral water

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Abstract

The findings of Elia et al [I7] (https://tinyurl.com/yabggn7d) could be regarded as a direct support for the notion of magnetic body (MB) carrying dark phases of ordinary matter with very large value of effective Planck constant $h_{eff} = nh_0$ equal to gravitational Planck constant $h_{gr} = GMm/v_0$ [**?**] [K11, K10, K9] predicting universal charge independent dark cyclotron energy spectrum proposed to be in visible and UV range characterizing bio-photons. One could even say that the freezing of chiral water involving sublimation of ordinary water leaves only frozen chiral water, whose formation is induced by magnetic flux tubes - maybe also magnetic flux tubes.

Chiral selection requires breaking of parity occurring for weak interactions in standard model but being extremely small because of the large mass of weak bosons. For large value of h_{eff} the Compton length below which weak bosons are massless can be even between cell membrane thickness and cell size so that the chiral selection for magnetic flux tubes would induce it for the water and basic bio-molecules.

There is strong similarity with Pollack's experiments [I3, I1, I8, I6] and the experiments related to water memory. Nafion membrane would play the role of gel phase in Pollack's experiments and provide a seed for flux tubes structures. In the case of water memory bio-active molecules would do this. Stirring brings in mind the basic method of homeopathy and could provide energy feed to generate dark matter at the flux tubes - increase of h_{eff} requires energy as also preservation of h_{eff} distribution. In Pollack's experiment irradiation would provide the energy. In general self-organization processes the energy feed would do the same.

The thin 2 nm thick chunks with sizes up to hundreds nm and 1 nm thick fibrils within 1 μm sized INW regions and resembling polymer networks bring in mind cell with minimal size around 1 μm. The 2-dimensionality of the network brings in mind endoplasmic reticulum within cells. The scales in nm range are also scales of DNA.

In the sequel a more detailed TGD inspired model for the findings is dicussed. The construction of the model forces also to consider more precisely the notions of p-adic and dark lenght scales.

Contents

1 Introduction

The findings of Elia et al (`https://tinyurl.com/yabggn7d`) could be regarded as a direct support for the notion of magnetic body (MB) carrying dark phases of ordinary matter with very large value of effective Planck constant $h_{eff} = nh_0$ equal to gravitational Planck constant $h_{gr} = GMm/v_0$ predicting universal charge independent dark cyclotron energy spectrum proposed to be in visible and UV range characterizing bio-photons. One could even say that the freezing of chiral water involving sublimation of ordinary water leaves only frozen chiral water, whose formation is induced by magnetic flux tubes - maybe also magnetic flux tubes.

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The TGD based interpretation applying with appropriate modifications also to the above listed experiments would be following.

1. Dark magnetic flux tubes forming helical structures analogous to dark DNA double strands would be in question. They would define kind of tentacles between water clusters and make the chiral water gel like phase. The increase of h_{eff} for ordinary protons would require energy since energies of quantum states in general increase with h_{eff}. Stirring would provide it.

2. Nafion would have the same role as gel phase bounding water in Pollack's experiments and leading to the formation of EZs. The protonic conductivity of Nafion would be due to the helical dark proton flux tubes carrying protonic currents - possibly supra currents with protons at paired flux tube portions forming Cooper pairs.

3. These flux tubes would gives rise to a population of entities living in primitive sense and able to replicate - perhaps in a manner analogous to DNA and stirring would provide the metabolic energy to build up this population using Nafion flux tubes as a model. There is analogy with water memory experiments and homeopathy. In Pollack's experiment gel phase would provide the templates and irradiation by say IR photons would provide the needed metabolic energy.

2 Article of Elia et al about chiral water

Earlier experiments providing support for induced chirality are listed first in the article of Elia et al [I7] (`https://tinyurl.com/yabggn7d`). If chiral selection for dark matter at magnetic flux tubes is responsible for the phenomenon there should be energy feed increasing the value of h_{eff} in all these cases.

1. At solid/liquid interfaces about 80 per cent of psysisorbed achiral molecules order chirally. Up-down asymmetry of the interface restricts the ordering. In this case one should be able to identify the source of energy feed. Physisorbtion occurs spontaneously and liberates therefore energy. The physisorbtion fixing the center of mass degrees of molecule: cold the liberated thermal energy allow to increase the value of h_{eff} for dark particles at flux tubes?

2. Stirring of liquids may induce chirality (it could also serve as a source of energy needed to increase h_{eff}). Laminar flows or vortices may align achiral macromolecules or supramolecular entities into chiral structures. Now the kinetic energy dissipated in fluid motion could serve as energy feed.

3. Liquid-liquid transitions in single-component isotropic liquids may case mirror-symmetry breaking. The energy liberated in the transition could generate the dark phase

4. During synthesis or on cooling below a critical temperature, chirality may arise spontaneously. Also in this case liberated energy could a provide the energy.

The article describes the procedure giving rise to chiral water. The procedure uses Nafion, which is organic compound having the special property that it allows proton conduction though to take place by hopping. One puts Nafion membrane to water , stirs the water, does this several times and measures conductivity which is found to increase. Nafion membrane is taken out of water ad dried and same procedure is repeated several times.

The properties of the chiral water are described.

1. Chiral water forms blobs of size of about micron and these form larger aggregates analogous to structures formed by cells. The structures below micron scale form structures analogous to polymer networks.

2. Lyophilizing the INW (Iterated Nafionized Water) sample means that it is freezed in such a manner that ordinary water sublimates from the sample. This leaves hat is called R_{INW} having interpretation as frozen chiral water. The structure of R_{INW} in various scales is analyzed. Micron sized structures persist. In scales above micron scales these structures consist of linear pieces bringing in mind flux tubes of thickness measured in microns.

   Below micron scale one has structure of polymer network. There consist of chunks of thickness of 2 nm and fibrils of thickness about 1 nm connecting them. Chunks have width up and fibrils length up to hundreds of nanometers. Also globules with size up to few nanometers are observable. (Fig S1 in the appendix of the article).

   Remark: Genetic codon in DNA strand corresponds to a distance about 1 nm and diameter of DNA helix is about 2.3 nm.

3. The chirality of INW is visible as different scattering rates for left and right polarizations of UV light - circular dichroism (CD). CD spectra depict the difference between the absorbance of left and right circularly polarized light as the function of UV radiation wave length. The difference is said to be non-vanishing in the range 190-240 nm. Figure 4,5,6 suggests that

there is a considerable asymmetry also below 190 nm. Maxima and minima with opposite signs are located around 195-198 nm and 215-22 nm respectively.

Also The UV absorption and emission spectra were studied. INW has absorbtion peak in 250-320 nm range with maximum at 280 nm absent in bulk water. INW fluorescence speak consist of a broad band in the range 290-320 nm.

Various spectra resemble in many respects the corresponding spectra for basic biomolecules like DNA and amino-acids. The connection with living matter is suggestive.

4. It is found that INW is far-out-of equilibrium, self-organizing, dissipative and hysteretic system.

5. The increase of conductivity correlating with the amount of chiral water would be due to the currents of protons alongs the chiral portions of water. The mechanism would be same in Nafion. Various physical properties are found to be correlated with the conductivity and therefore with the size of chiral aggregates and number of them and this is understandable if the chiral aggregates determine these properties in good approximation.

6. The temperature at which the chiral asymmetry CD is not visible anymore is about 80 Celsius and should correspond to the energy difference between particle states assignable to flux tubes associated with the two chiral supermolecules.

3 General TGD inspired ideas about chiral water

3.1 Chiral water as Pollack's fourth phase of water?

1. At the first glance chiral water looks just what I expected and chirality of water around DNA could be induced by the dark DNA forming helical strands as magnetic flux tubes parallel to DNA and consisting of dark proton triplets as codons thrown out as negatively charged EZ is formed. Overall charge neutrality would be guaranteed. In the case of proteins the dark counterpart of amino-acid should be neutral- protons should be in some sense be replaced by neutron like states. This is possible if the flux tubes bonds connecting dark protons analogous to pions are charged having negative charge. One cannot exclude the possibility that even nuclear neutrons correspond to this kind of states.

2. Chiral selection for dark DNA caused by dark variant of weak interactions with rather large h_{eff} would induce chiral selection for U-shaped helical flux tubes of which dark DNA would represent one example. This of course raises the question whether dark DNA is realized for all U-shaped tentacles and genetic code is present in biology also outside DNA.

3.2 Dry water as chiral water as Pollack's fourth phase of water?

I understood that "dry" water would be synonymous to chiral water. One can also ask whether chiral water corresponds to Pollack's fourth phase of water.

1. The article at `https://tinyurl.com/yav4dam6` tells about dry water. For dry water the size of the silica particles forming a coating around dry water blobs is in the range of 5-20 nanometers. Brings in mind DNA size scales and cell membrane thickness. Could cell membrane have inside it "dry" water.

   It was mentioned in the article that that in dry water silica particles form coating around the blobs of water with a size of sand grain: what does this exactly mean? What is the typical size of the blobs. Cell size or larger? Chiral water blobs have size of 1 micrometer, cell size roughly. This coating would prevent dry water particles to fuse together.

2. My first guess was that "dry" water is "ordinary" in the sense that there are now dark proton flux tubes. If dry water is chiral then I would have been wrong. Formation of blobs would suggest coherence in the scale of blobs induced by that at magnetic body so that blobs would be gel like in the interior. It seems that I was wrong.

3. In biology cell membranes would take the role of the silica coating. Hydrophobic ends of the two lipids layers would be however in the interiors of membrane. So that single lipid layer would take the role of silica coating.

   Silica particles are hydrophobic. This would conform with the idea that dry water corresponds chiral water, the water around DNA. Dry water could also correspond to Pollack's fourth phase of water. The key question is whether there is charge separation present in some scale in chiral water.

3.3 Hydrophobia and DNA transcription and translations

Hydrophobia of silica particles is essential. Hydrophobia/hydrophilia relates interestingly to DNA transcription and replication.

1. What would be certainly required in transcription/replication would be melting of the surrounding ordered water/Pollack's phase consisting of hexagonal layers so that water would get inside DNA. But is this enough?

2. Consider first the situation assuming nucleotide-wise transcription/replication as done usually. The problem are the hydrophobic nucleotides in the interior of DNA. Should they get rid of their hydrophobia? Should water change to achieve this.

   The reduction of h_{eff} for the flux tubes connecting DNA to the RNA and DNA building bricks would liberate energy and make possible for the reactions to proceed swiftly. Flux tubes would shorten and bring reactants together. This would be a general mechanism of bio-catalysis.

3. One could take cancer as a guideline.

   (a) It is suggested that in cancer this kind of change of water occurs and occurs too easily and leads to too easy transcription of DNA.

   If the h_{eff} decreases too easily the reaction leading to transcription would occur too easily. h_{eff} serves also as "IQ" of magnetic flux flux tubes of surrounding water and would be reduced too easily. Quantum coherence length would shorten and this could mean cancer.

   Why water with smaller than normal h_{eff} - perhaps $h_{eff} = h$ - around DNA would not cause hydrophobia, remains an open question. Therefore this option is not feasible looking.

   (b) One could be brave and assume that the idea about transcription and replication taking place nucleotide-wise is wrong. RNA is indeed known to be transcribed also in codon-wise manner. The view about dark DNA actually forces the proposal that it actually takes place in codon wise manner and RNA and DNA letters outside DNA form "loose" codons.

   This would change the view about the role of hydrophobia at the level of individual nucleotides since basic objects would be codons and represent larger space-time sheets in the hierarchy. Furthermore, the replication and transcription of dark DNA would induce this process at the level of ordinary DNA.

3.4 Wetting and flows of water near surfaces

Wetting is related to hydrophily in turn related to the flows near surfaces. How friction and hydrophilia/hydrophobia relate in the case of flows? One would expect that hydrophobia of surface molecules reduces friction and hydrophily increases.

But could there a surface layer with h_{eff} larger than its value h_{int} in the interior of flow? Friction would induce liberation of energy. Could this energy serve as metabolic energy exciting $h_{eff} \geq h_{int}$ phases. Could a layer of (more) ordered water - EZ of Pollack - change the situation so that there would be flow of water along this ice layer with smaller friction (see `https://tinyurl.com/yauzrj6z`).

4 About p-adic length scale hypothesis and dark matter hierarchy

It is good to introduce first some background related to p-adic length scale hypothesis discussed in chapters of [K8] and dark matter hierarchy discussed in chapters [K6, K7], in particular in chatper [K9].

4.1 Basic ideas behind number theoretic physics

It is best to represent the general vision first.

4.1.1 p-Adic length scale hypothesis

In p-adic mass calculations [K3] real mass squared is obtained by so called canonical identification from p-adic valued mass squared identified as analog of thermodynamical mass squared using p-adic generelization of thermodynamics assuming super-conformal invariance and Kac-Moody algebras assignable to isometries ad holonomies of $H = M^4 \times CP_2$. This implies that the mass squared is essentially the expectation value of sum of scaling generators associated with various tensor factors of the representations for the direct sum of super-conformal algebras and if the number of factors is 5 one obtains rather predictive scenario since the p-adic temperature T_p must be inverse integer in order that the analogs of Boltzmann factors identified essentially as p^{L_0/T_p}.

The p-adic mass squared is of form $Xp + O(p^2)$ and mapped to $X/p + O(1/p^2)$. For the p-adic primes assignable to elementary particles ($M_{127} = 2^{127} - 1$ for electron) the higher order corrections are in general extremely small unless the coefficient of second order contribution is larger integer of order p so that calculations are practically exact.

Elementary particles seem to correspond to p-adic primes near powers 2^k. Corresponding p-adic length - and time scales would come as half-octaves of basic scale if all integers k are allowed. For odd values of k one would have octaves as analog for period doubling. In chaotic systems also the generalization of period doubling in which prime $p = 2$ is replaced by some other small prime appear and there is indeed evidence for powers of $p = 3$ (period tripling as approach to chaos). Many elementary particles and also hadron physics and electroweak physics seem to correspond to Mersenne primes and Gaussian Mersennes which are maximally near to powers of 2.

For given prime p also higher powers of p define p-adic length scales: for instance, for electron the secondary p-adic time scale is .1 seconds characterizing fundamental bio-rhythm. Quite generally, elementary particles would be accompanied by macroscopic length and time scales perhaps assignable to their magnetic bodies or causal diamonds (CDs) accompanying them.

This inspired p-adic length scale hypothesis stating the size scales of space-time surface correspond to primes near half-octaves of 2. The predictions of p-adic are exponentially sensitive to the value of k and their success gives strong support for p-adic length scale hypothesis. This hypothesis applied not only to elementary particle physics but also to biology and even astrophysics and cosmology. TGD Universe could be p-adic fractal.

4.1.2 Dark matter as phases of ordinary matter with $h_{eff} = nh_0$

The identification of dark matter as phases of ordinary matter with effective Planck constant $h_{eff} = nh_0$ is second key hypothesis of TGD. To be precise, these phases behave like dark matter and galactic dark matter could correspond to dark energy in TGD sense assignable to cosmic strings thickened to magnetic flux tubes.

There are good arguments in favor of the identification $h = 6h_0$ [L1, L5]. "Effective" means that the actual value of Planck constant is h_0 but in many-sheeted space-time n counts the number of symmetry related space-time sheets defining space-time surface as a covering. Each sheet gives identical contribution to action and this implies that effective value of Planck constant is nh_0.

4.1.3 $M^8 - H$ duality

$M^8 - H$ duality ($H = M^4 \times CP_2$) [L7] has taken a central role in TGD framework. $M^8 - H$ duality allows to identify space-time regions as "roots" of octonionic polynomials in complexified

M^8. The polynomial is obtained from ordinary real polynomial P with rational coefficients by algebraic continuation. One obtains brane-like 6-surfaces as 6-spheres as universal solutions. They have M^4 projection which is piece of hyper-surface for which Minkowski time as time coordinate of CD corresponds to a root $t = r_n$ of P. For monic polynomials these time values are algebraic integers and Galois group permutes them.

$M^8 - H$ duality allows to map space-time surfaces in M^8 to H so that one has two equivalent descriptions for the space-time surfaces as algebraic surfaces in M^8 and as minimal surfaces with 2-D singularities in H satisfying an infinite number of additional conditions stating vanishing of Noether charges for super-symplectic algebra actings as isometries for the "world of classical worlds" (WCW). Twistor lift allows variants of this duality. M^8_Hduality predicts that space-time surfaces form a hierarchy induced by the hierarchy of extensions of rationals defining an evolutionary hierarchy. This forms the basis for the number theoretical vision about TGD.

During the writing of this article I realized that $M^8 - H$ duality has very nice interpretation in terms of symmetries. For $H = M^4 \times CP_2$ the isometries correspond to Poincare symmetries and color $SU(3)$ plus electroweak symmetries as holonomies of CP_2. For octonionic M^8 the subgroup $SU(3) \subset G_2$ is the sub-group of octonionic automorphisms leaving fixed octonionic imaginary unit invariant - this is essential for $M^8 - H$ duality. $SU(3)$ is also subgroup of $SO(6) \equiv SU(4)$ acting as rotation on $M^8 = M^2 \times E^6$. The sub-group of the holonomy group of $SO(4)$ for E^4 factor of $M^8 = M^4 \times E^4$ is $SU(2) \times U(1)$ and would correspond to electroweak symmetries. One can say that at the level of M^8 one has symmetry breaking from $SO(6)$ to $SU(3)$ and from $SO(4) = SU(2) \times SO(3)$ to $U(2)$.

This interpretation justifies for the earlier proposal that the descriptions provided by the old-fashioned low energy hadron physics assuming $SU(2)_L \times SU(2)_R$ and acting acting as covering group for isometries $SO(4)$ of E^4 and by high energy hadron physics relying on color group $SU(3)$ are dual to each other.

4.1.4 Number theoretic origin of p-adic primes and dark matter

There are several questions to be answered. How to fuse real number based physics with various p-adic physics? How p-adic length scale hypothesis and dark matter hypothesis emerge from TGD?

The properties of p-adic number fields and the strange failure of complete non-determinism for p-adic differential equations led to the proposal that p-adic physics might serve as a correlate for cognition, imagination, and intention. This led to a development of number theoretic vision which I call adelic physics. A given adele corresponds to a fusion of reals and extensions of various p-adic number fields induced by a given extension of rationals.

The notion of space-time generalizes to a book like structure having real space-time surfaces and their p-adic counterparts as pages. The common points of pages defining is back correspond to points with coordinates in the extension of rationals considered. This discretization of space-time surface is in general finite and unique and is identified as what I call cognitive representation. The Galois group of extension becomes symmetry group in cognitive degrees of freedom. The ramified primes of extension are exceptionally interesting and are identified as preferred p-adic primes for the extension considered.

The basic challenge is to identify dark scale. There are some reasons to expect correlation between p-adic and dark scales which would mean that the dark scale would depend on ramified primes, which characterize roots of the polynomial defining the extensions and are thus not defined completely by extension alone. Same extension can be defined by many polynomials. The naive guess is that the scale is proportional to the dimension n of extension serving as a measure for algebraic complexity (there are also other measures). p-Adic length scales L_p would be proportional nL_p, p ramified prime of extension? The motivation would be that quantum scales are typically proportional to Planck constant. It turns out that the identification of CD scale as dark scale is rather natural.

4.2 General form of p-adic length scale hypothesis

The most general form of p-adic length scale hypothesis does not pose conditions on allowed p-adic primes and emerges from p-adic mass calculations [K1, K3, K4]. It has two forms corresponding to massive particles and massless particles.

1. For massive particles the preferred p-adic mass calculations based on p-adic thermodynamics predicts the p-adic mass squared m^2 to be proportional to p or its power- the real counterpart of m^2 is proportional to $1/p$ or its power. In the simplest case one has

$$m^2 = \frac{X}{p}\frac{\hbar}{L_0} \quad ,$$

where L_0 is apart from numerical constant the length R of CP_2 geodesic circle. X is a numerical constant not far from unity. $X \geq 1$ is small integer in good approximation. For instance for electron one has $x = 5$.

By Uncertainty Principle the Compton length of particle is characterizing the size of 3-surfaces assignable to particle are proportional to $\sqrt{p}$:

$$L_c(m) = \frac{\hbar}{m} = \sqrt{\frac{1}{X}}L_p \quad , \quad L_p = \sqrt{p}L_0 = \quad .$$

Here L_p is p-adic length scale and corresponds to minimal mass for given p-adic prime. p-Adic length scale would be would characterize the size of the 3-surface assignable to the particle and would correspond to Compton length.

2. For massless particles mass vanishes and the above picture is not possible unless there is very small mass coming from p-adic thermodynamics and determined by the size scale of CD - this is quite possible. The preferred time/spatial scales p-adic energy- equivalently 3-momentum are proportional to p-adic prime p or its power. The real energy is proportional to $1/p$. At the imbedding space level the size of scale causal diamond (CD) [L9] would be proportional to p: $L = T = pL_0$, $L_0 = T_0$ for $c = 1$. The interpretation in terms of Uncertainty Principle is possible.

There would be therefore two levels: space-time level and imbedding space level . At the space-time level the primary p-adic length scale would be proportional to $\sqrt{p}$ whereas the p-adic length scale at imbedding space-time would correspond to secondary p-adic length scale proportional to p. The secondary p-adic length scales would assign to elementary new physics in macroscopic scales. For electron the size scale of CD would be about .1 seconds, the time scale associated with the fundamental bio-rhythm of about 10 Hz.

3. A third piece in the picture is adelic physics [L3, L4] inspiring the hypothesis that effective Planck constant h_{eff} given by $h_{eff}/h_0 = n$, $h = 6h_0$, labels the phases of ordinary matter identified as dark matter. n would correspond to the dimension of extension of rationals.

The connection between preferred primes and the value of $n = h_{eff}/h_0$ is interesting. One proposal is that preferred primes p in p-adic length scale hypothesis determining the mass scale of particle correspond to so called ramified primes, which characterize the extensions. The p-adic variant of the polynomial defining space-time surfaces in M^8 picture would have vanishing discriminant in order $O(p)$. Since discriminant is proportional to the product of differences of different roots of the polynomial, two roots would be very near to each other p-adically. This would be mathematical correlate for criticality in p-adic sense.

$M^8 - H$ duality [L7, L6] leads to the prediction that the roots r_n of polynomial defining the space-time region in M^8 correspond to preferred time values $t = t_n = \propto r_n$- I have called $t = t_n$ "special moments in the life of self". Since the squares for the differences for the roots are proportional to ramified primes, these time differences would code for ramified primes assignable to the space-time surface. There would be several p-adic time scales involved and they would be coded by $t_{ij} = r_i - r_j$, whose moduli squared are divided by so called ramified primes defining excellent candidates for preferred p-adic primes. p-Adic physics would make itself visible at the level of space-time surface in terms of "special moments in the life of self".

4. p-Adic length scales emerge naturally from $M^8 - H$ duality [L7, L6]. Ramified primes would in M^8 picture appear as factors of time differences associated with "special moments in the life of self" associated with CD [L6]. One has $|t_i - t_j| \propto \sqrt{p_{ij}}$, p_{ij} ramified prime. It is essential that square root of ramified prime appears here.

This suggests strongly that p-adic length scale hypothesis is realized at the level of space-time surface and there are several p-adic length scales present coded to the time differences. Knowing of the polynomial would give information about p-adic physics involved. If dark scales correlate with p-adic length scales as proposed, the definition of dark scale should assume the dependence of ramified primes quite generally rather than as a result of number theoretic survival of fittest as one might also think.

The factors $t_i - t_j$ are proportional - not only to the typically very large p-adic prime p_{max} charactering the system - but also smaller primes or their powers. Could the scales in question be of form $l_p = \sqrt{X}\sqrt{p_{max}}L_0$ rather than p-adic length scales $L_{p_{ram}}$ defined by various ramified primes. Here X would be integer consisting of small ramified primes.

p-Adic mass calculations predict in an excellent approximation the mass of the particle is given by $m = (\sqrt{X}/\sqrt{p})m_0$, X small integer and $m_0 = 1/L_0$. Compton length would be given by $L_c(p) = \sqrt{p}/\sqrt{X})L_0$. The identification $l_p = L_c(p)$ would be attractive but is not possible unless one has $X = 1$. In this case one would be considering p-adic length scale L_p. The the interpretation in terms of multi-p-adicity seems to be the realistic option.

4.3 About more detailed form of p-adic length scale hypothesis

More specific form of p-adic length scale hypothesis poses conditions on physically preferred p-adic primes. There are several guesses for preferred primes. They could be primes near to integer powers 2^k, where k could be positive integer, which could satisfy additional conditions such as being odd, prime or be associated with Mersenne prime or Gaussian Mersenne. One can consider also powers of other small primes such as $p = 2, 3, 5$. p-Adic length scale hypothesis in is basic form would generalize the notion of period doubling. For odd values of k one would indeed obtain period doubling, tripling, etc... suggesting strongly chaos theoretic origin.

4.3.1 p-Adic length scale hypothesis in its basic form

Consider first p-adic length scale hypothesis in its basic form.

1. In its basic form states that primes $p \simeq 2^k$ are preferred p-adic primes and correspond by p-adic mass calculations p-adic length scales $L_p \equiv L(k) \propto \sqrt{p} = 2^{k/2}$. Mersenne primes and primes associated with Gaussian Mersennes as especially favored primes and charged leptons ($k \in \{127, 113, 107\}$) and Higgs boson ($k = 89$) correspond to them. Also hadron physics ($k = 107$) and nuclear physics ($k = 113$) correspond to these scales. One can assign also to hadron physics Mersenne prime and the conjecture is that Mersennes and Gaussian Mersennes define scaled variants of hadron physics and electroweak physics. In the length scale between cell membrane thickness fo 10 nm and nuclear size about 2.5 μm there are as many as 4 Gaussian Mersennes corresponding to $k \in \{151, 157, 163, 167\}$.

   Mersenne primes correspond to prime values of k and I have proposed that k is prime for fundamental p-adic length scales quite generally. There are also however also other p-adic length scales - for instance, for quarks k need not be prime - and it has remained unclear what criterion could select the preferred exponents k. One can consider also the option that odd values of k defined fundamental p-adic length scales.

2. What makes p-adic length scale hypothesis powerful is that masses of say scaled up variant of hadron physics can be estimated by simple scaling arguments. It is convenient to use electron's p-adic length scale and calculate other p-adic length scales by scaling $L(k) = 2^{(k-127)/2}L(127)$.

Here one must make clear that there has been a confusion in the definitions, which was originally due to a calculational error.

1. I identified the p-adic length scale $L(151)$ mistakenly as $L(151) = 2^{(k-127)/2}L_e(127)$ by using instead of $L(127)$ electron Compton length $L_e \simeq L(127/\sqrt{5}$. The notation for these scales would be therefore $L_e(k)$ identified as $L_e(k) = 2^{(k-127)/2}L_e(127)$ and I have tried to use it systematically but failed to use the wrong notation in informal discussions.

2. This mistake might reflect highly non-trivial physics. It is scaled up variants of L_e which seem to appear in physics. For instance, $L_e(151) \simeq 10$ nm corresponds to basic scale in living matter. Why the biological important scales should correspond to scaled up Compton lengths for electron? Could dark electrons with scaled up Compton scales equal to $L_e(k)$ be important in these scales? And what about the real p-adic length scales relate to these scales by a scaling factor $\sqrt{5} \simeq 2.23$?

4.3.2 Possible modifications of the p-adic length scale hypothesis

One can consider also possible modifications of the the p-adic length scale hypothesis. In an attempt to understand the scales associated with INW structures in terms of p-adic length scale hypothesis it occurred to me that the scales which do not correspond to Mersenne primes or Gaussian Mersennes might be generated somehow from the these scales.

1. Geometric mean $L = \sqrt{L(k_1)L(k_2)}$ would length scale which would correspond to L_p with $p \simeq 2^{(k_1+k_2)/2}$. This is of the required form only if $k = k_1 + k_2$ is even so that k_1 and k_2 are both even or odd. If one starts from Mersennes and Gaussian Mersennes the condition is satisfied. The value of $k = (k_1 + k_2)/2$ can be also even.

   Remark: The geometric mean $(127 + 107)/2 = 117$ of electronic and hadronic Mersennes corresponding to mass 16 MeV rather near to the mass of so called X boson [L2] (`https://tinyurl.com/ya3yuzeb`).

2. One can also consider the formula $L = (L(k_1)L(k_2)..L(k_n))^{1/n}$ but in this case the scale would correspond to prime $p \simeq 2^{k_1+...k_n)/n}$. Since $(k_1 + ..k_n)/n$ is integer only if $k_1 + ...k_n$ is proportional to n.

What about the allowed values of fundamental integers k? It seems that one must allow all odd integers.

1. If only prime values of k are allowed, one can obtain obtain for twin prime pair $(k-1, k+1)$ even integer k as geometric mean $\sqrt{k}$ if k is square. If prime k is not a member of this kind of pair, it is not possible to get integers $k-1$ and $k+1$. If only prime values of k are fundamental, one could assign to $k = 89$ characterizing Higgs boson weak bosons $k = 90$ possibly characterizing weak bosons. Therefore it seems that one must allow all odd integers with the additional condition already explained.

2. Just for fun one can check whether $k = 161$ forced by the argument related to electroweak scale and h_{eff} corresponds to a geometric mean of two Gaussian Mersennes. One has $k(k_1, k_2) = (k_2 + k_2)/2$ giving the list $k(151, 157) = 154)$, $k(151, 163) = 157$ Gaussian Mersenne itself, $k(151, 167) = 159$, $k(157, 163) = 160$, $k(157, 167) = 162$, $k(163, 167) = 165$. Unfortunately, $k = 161$ does not belong to this set. If one allows all odd values of k as fundamental, the problem disappears.

One can also consider refinements of p-adic length scale hypothesis in its basic form.

1. One can consider also a generalization of p-adic length scale hypothesis to allow length scales coming as powers of small primes. The small primes $p = 2, 3, 5$ assignable to Platonic solids would be especially interesting. $p = 2, 3, 5$ and also Fermat primes and Mersenne primes are maximally near to powers of two and their powers would define secondary and higher p-adic length scales. In this sense the extension would not actually bring anything new.

   There is evidence for the occurrence of long p-adic time scales coming as powers of 3 [I4, I5] (`http://tinyurl.com/ycesc5mq`) and [K5] (`https://tinyurl.com/y8camqlt`. Furthermore, prime 5 and Golden Mean are related closely to DNA helical structure. Portion of DNA with L(151) contains 10 DNA codons and is the minimal length containing an integer number of codons.

2. The presence of length scales associated with 1 nm and 2 nm thick structures encourage to consider the possibility of p-adic primes near integers $2^k 3^l 5^m$ defining generators of multiplicative ideals of integers. They do not satisfy the maximal nearness criterion anymore but

would be near to integers representable as products of powers of primes maximally near to powers of two.

What could be the interpretation of the integer k appearing in $p \simeq 2^k$? Elementary particle quantum numbers would be associated with wormhole contacts with size scale of CP_2 whereas elementary particles correspond to p-adic size scale about Compton length. What could determine the size scale of wormhole contact? I have proposed that to p-adic length scale there is associated a scale characterizing wormhole contact and depending logarithmically on it and corresponds to $L_k = (1/2)log(p)L_0 = (k/2)log(2)L_0$. The generalization of this hypothesis to the case of $p \simeq 2^k 3^l 5^m ...$ be straightforward and be $L_{k,l,m} = (1/2)(klog(2) + llog(3) + mlog(5) + ..)$.

4.4 Dark scales and scales of CDs and their relation to p-adic length scale hierarchy

There are two length scale hierarchies. p-Adic length scale hierarchy assignable to space-time surfaces and the dark hierarchy assignable to CDs. One should find an identification of dark scales and understand their relationship to p-adic length scales.

4.4.1 Identification of dark scales

The dimension n of the extension provides the roughest measure for its complexity via the formula $h_{eff}/h_0 = n$. The basic - rather ad hoc - assumption has been that n as dimension of extension defines not only h_{eff} but also the size scale of CD via $L = nL_0$.

This assumption need not be true generally and already the attempt to understand gravitational constant [L10] as a prediction of TGD led to the proposal that gravitational Planck constant $h_{gr} = n_{gr}h_0 = GMm/v_0$ [**?**] could be coded by the data relating to a normal subgroup of Galois group appearing as a factor of n.

The most general option is that dark scale is coded by a data related to extension of its sub-extension and this data involves ramified primes. Ramified primes depend on the polynomial defining the extension and there is large number polynomials defining the same extension. Therefore ramified ramifies code information also about polynomial and dynamics of space-time surface.

First some observations.

1. For Galois extension the order n has a natural decomposition to a product of orders n_i of its normal subgroups serving also as dimensions of corresponding extensions: $n = \prod_i n_i$. This implies a decomposition of the group algebra of Galois group to a tensor product of state spaces with dimensions n_i [L12].

2. Could one actually identify several dark scales as the proposed identifications of gravitational, electromagnetic, etc variants of h_{eff} suggest? The hierarchy of normal subgroups of Galois group of rationals corresponds to sub-groups with orders given by $N(i,1) = n_i n_{i-1} ... n_{i-1}$ of n define orders for the normal subgroups of Galois group. For extensions of $k-1$:th extension of rationals one has $N(i,k) = n_i n_{i-1} ... n_{i-k}$. The most general option is that these normal subgroups provide only the data allowing to associate dark scales to each of them. The spectrum of h_{eff} could correspond to the $\{N_{i,k}\}$ or at least the set $\{N_{i,1}\}$.

3. The extensions with prime dimension $n = p$ have no non-trivial normal subgroups and $n = p$ would hold for them. For these extensions the state space of group algebra is prime as Hilbert space and does not decompose to tensor product so that it would represent fundamental system. Could these extensions be of special interest physically? SSFRs would naturally involve state function reduction cascades proceeding downwards along hierarchy of normal subgroups and would represent cognitive measurements [L12].

The original guess was that dark scale $L_D = nL_p$, where n is the order n for the extensions and p is a ramified prime for the extension. A generalized form would allow $L_D = N(i,1)L_{p_k}$ for the sub-extension such that $p_k$is ramified prime for the sub-extension.

4.4.2 Can one identify the size scale of CD as dark scale?

It would be natural if the scale of CD would be determined by the extension of rationals. Or more generally, the scales of CD and hierarchy of sub-CDs associated with the extension would be determined by the inclusion hierarchy of extensions and thus correspond to the hierarchy of normal sub-groups of Galois group.

The simplest option would be $L_{CD} = L_D$ so that the size scales of sub-CD would correspond dark scales for sub-extension given by $L_{CD,i} = N(i,1)L_{p_k}$, p_k ramified prime of sub-extension.

1. The differences $|r_i - r_j|$ would correspond to differences for Minkowski time of CD. CD need not contain all values of hyperplanes $t = r_i$ and the evolution by SSFR would gradually bring in day-light all roots r_n of the polynomial P defining space-time surface as "very special moments in the life of self". If the size scale of CD is so large that also the largest value of $|r_i|$ is inside the upper or lower half of CD, the size scale of CD would correspond roughly to the largest p-adic length scale.

   CD contains sub-CDs and these could correspond to normal subgroups of Galois extension as extension of extension of ....

2. One can ask what happens when all special moments $t = r_n$ have been experienced? Does BSFR meaning death of conscious entity take place or is there some other option? In [L11] I considered a proposal for how chaos could emerge via iterations of P during the sequence of SSFRs.

   One could argue that when CD has reached by SSFRs following unitary evolutions a size for which all roots r_n have become visible, the evolution could continues by the replacement of P with $P \circ P$, and so on. This would give rise to iteration and space-time analog for the approach to chaos.

3. Eventually the evolution by SSFRs must stop. Biological arguments suggests that metabolic limitations cause the death of self since the metabolic energy feed is not enough to preserve the distribution of values of h_{eff} (energies increase with $h_{eff} \propto Nn$, for N:th iteration and h_{eff} is reduced spontaneously) [L13].

5 TGD based quantitative interpretation of the results of Elia et al

The general TGD based model for chiral selection in terms of dark weak interactions has been already introduced. In the following I will try to understand the findings of Elia et al in TGD framework using p-adic length scale hypothesis in its standard form also in generalized form?

5.1 The energies of UV photons and p-adic length scale hypothesis

1. In zero energy ontology (ZEO) [L9, L13] all self-organizing systems could correspond to systems in which "big" (ordinary) macroscopic state function reductions reversing the arrow of time occur at the level of MB controlling the ordinary matter, "biological body" (BB) [L8]. Dissipation in reversed time direction would look like metabolic energy feed and decay of structures and gradients as their generation: these are the basic elements of self-organization [L8]. Self-organization alone could be seen as a support for macroscopic quantum jumps and ZEO.

2. If magnetic flux tubes or at least if the chiral water structures induced by the presence of flux tubes are responsible for the scattering, one can understand why the spectra resembles those for the basic biomolecules in water. This would allow even say that the findings have made the magnetic flux tubes visible. Furthermore, the chirality impossible in standard physics would provide support for the view that dark variant of weak interactions is involved in sub-cellular scales.

3. TGD suggests that part of UV photons transforms to dark cyclotron photons and excite cyclotron states of Cooper pairs with members at parallel strands of U-shaped helical flux tube. The strength of the magnetic field at the flux tube must be guessed. If the magnetic field has magnitude of order $B_{end} = .2$ Gauss, its magnetic length would correspond to few micron size scale observed as the size scale of chiral water blobs. The value of $h_{eff} = h_{gr}$ would be of the same order of magnitude as in living matter and the energy scale would not depend on mass of the particle (electron, proton, ion).

   If one assumes that the cyclotron energies $E_c = \hbar_{gr} f_c$ correspond to the energies of UV radiation. This would mean that they are also bio-photon energies. $E_c = 3.5$ eV would corresponds to cyclotron energy $E_c = 3.5$ eV independent of charge particle mass for $h_{eff} = h_{gr}$, one would have $\Delta E/E_c \simeq 10^{-3}$.

4. The energy splitting ΔE between different chiralities should correspond to to temperature about 80 °C. The scale of energy splitting would be of order $\Delta E \sim T = 0.035$ eV, which of same order of magnitude as energy eV associated with the voltage difference over cell membrane. ΔE could be seen as being due to the coupling of charged particle to classical Z^0 field and assignable to the violation of parity asymmetry and assignable most naturally to the presence of classical Z^0 field. These are indeed possible in TGD space-time and I have speculated with their physical role.

   Below scaled up Compton length of weak bosons parity violation and splitting energy would be large. For instance, if ordinary weak bosons correspond to p-adic length scale $L_p \propto \sqrt{p}$, $p \simeq 2^k$, $k = 90$ and dark weak boson Compton length to the p-adic length scale $L(k)$, $k = 167$, for the flux tubes of $B_{end} = .2$ Gauss, one would have scaling factor of Compton length $\hbar_{eff}/\hbar = \hbar_{gr}/\hbar \simeq 2^{(167-90)/2} = 2^{38+1/2} \simeq .35 \times 10^{12}$.

   Another identification - the original one for weak boson mass scale is as $k = 89$ and this certainly looks more natural identification. This gives the $\sqrt{n/n_0} = \sqrt{\hbar_{eff}/\hbar} = \sqrt{\hbar_{gr}/\hbar} \simeq 2^{(167-89)/2} = 2^{39} \simeq .5 \times 10^{12} = 2 \times 10^{11}$. This number is reported by Cyril Smith as a scaling factor for photon wave lengths in water memory experiments [I2] [K2] (`https://tinyurl.com/rw9jzcp`). This puts bells ringing.

   The application of p-adic length scale hypothesis for massive particles requires that photon as small mass given by p-adic mass calculations. It would naturally correspond to size scale of the CD involved.

5. The maximum absorption of UV light occurs around $E = 4.6$ eV (270 nm) giving reasonable guess for E_c as $E_c = 4.6$ eV. For proton $f_c = 300$ Hz in $B_{end} = .2$ Gauss would give cyclotron energy $E_c = \hbar_{gr} f_c = .5$ eV, which corresponds to IR wavelength and is by a factor of about 1/9 smaller than $E_c = 4.6$ eV.

   Remark: That .5 eV is identifiable as the nominal value of metabolic energy quantum puts second bell ringing.

   One expects a hierarchy of values of B_{end} scaling like $1/L(k)^2$. Shorter p-adic length scale $L(k)$ and stronger value of B_{end} is suggestive. E_c would scale like $1/L(k)$. For $L(161)$ one would obtain $E_c \to 2^3 E_c \simeq 4$ eV (310 nm), which differs considerably from 270 nm. The scaling $B_{end} \to (4.6/4)B_{end} = 1.15 B_{end}$ would cure the discrepancy.

   Remark: The primes $k \in \{151, 157, 163, 167\}$ define Gaussian Mersennes $G_{N,k} = (1+i)^k - 1$, for which p-adic length scales are in the range between cell membrane thickness 10 nm and size scale 2.5 μm of cell nucleus. This is a number theoretical miracle.

5.2 Could the size scales of sub-micrometer structures be understood using a generalized form of p-adic length scale hypothesis?

One should also understand the sub-micrometer structures with height scale 1 nm and 2 m suggesting interpretation as analogs of polymers consisting of beta sheets and pieces of polymer connecting the sheets? These scales are naturally assignable to DNA strands. It seems that p-adic length scale hypothesis allowing only powers of 2 does might be too restricted to allow these scales.

1. The ratio of 1 nm scale to the scale of neuronal membrane thickness $L(151) = 10$ nm appearing very often in biology equals to 10. This is not a ratio of p-adic lengths scales allowed by p-adic length scale hypothesis: $k = 45$ would give 1.25 nm length scale instead of 1 nm. The discrepancy looks too large. Since one has $5^3 = 125 \simeq = 128 = 2^7$ One could understand these scales as scales $5^2L(137)$ and $5^2L(135)$.

   This encourages to consider the possibility of p-adic primes near integers $2^k3^l5^m$ defining generators of multiplicative ideals of integers. They do not satisfy the maximal nearness criterion anymore but would be near to integers representable as products of powers of primes maximally near to powers of two. The above mentioned scales would correspond p near $5^4 \times 2^{137}$.

2. The connection between preferred primes and the value of $n = h_{eff}/h_0$ is interesting. One proposal is that preferred primes correspond to so called ramified primes, which characterize the extensions. The p-adic variant of the polynomial defining space-time surfaces in M^8 picture would reduce have vanishing discriminant in order $O(p)$. Since discriminant is proportional to the product of differences of different roots of the polynomial, two roots would be very near to each other p-adically. This would be mathematical correlate for criticality in p-adic sense.

   Ordinary weak bosons would be characterized by $n = h_{eff}/h_0$ corresponding to $n = n_0 = 6$. Dark weak boson would have $n \geq\geq n_0$. Can one assume that the ratio n/n_0 is near to the ratio of secondary p-adic length scales with n and n_0. This ratio would be ratio of ramified primes for extension of rationals with dimension n and n_0. This would imply $p(M_{G,167})/M_{89} \simeq n(167)/6)$. There should be a root pair for which difference is proportional to $p(M_{G,167}) \simeq M_{89} \times (n(167)/6)$ giving $n(167) \simeq M_{89}/6$. Generalization for general fundamental preferred prime p_{pref} would be $n(p_{dark})/n_0 = p_{pref}/6$.

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