Exploration

Three Alternative Generalizations of Nottale's Hypothesis in the TGD framework

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Abstract

Nottale's gravitational Planck constant $\hbar_{gr} = GMm/v_0$ contains the velocity parameter v_0 as the only parameter. In the perturbative expansion of the scattering amplitudes $\beta_0 = v_0/c$ appears in the role of fine structure constant. There is however a problem:

1. The model for the effects of ELF radiation on vertebrate brain inspired by a generalization of Nottale's hypothesis by replacing the total mass M in the case of Earth by $M_D \simeq 10^{-4}M_E$ suggests that in this case the dark particles involved couple only to a part of mass identifiable as dark mass M_D.
2. Since only GM appears in the basic formulas, the alternative option is that the value of G is reduced to G_D. This conforms with the fact that in the TGD framework CP_2 length is the fundamental parameter G is a prediction of the theory and therefore can vary.
3. A further option is that the parameter $\beta_0 = v_0/c \leq 1$ is variable and equals to $\beta_0 = 1$ or to a value not much smaller than 1, say $\beta_0 = 1/2$.

In this article these three options are critically discussed and compared. The cautious conclusion is that the the third option is the most plausible one.

1 Introduction

Gravitational Planck constant $h_{gr} = GMm/v_0$ was originally introduced by [1] and its form realizes Equivalence Principle (EP) in its Newtonian form (gravitational acceleration does not depend on mass m). The generalization of the idea was formulated in the TGD framework in [14, 13]. $h_{eff} = nh_0 = h_{gr}$ would characterize the U-shaped flux tube tentacles emanating from M and mediating gravitational interaction.

One implication is that the parameter $v_0/c = \beta_0 < 1$ appears as a natural expansion parameter of the gravitational scattering amplitudes in the perturbative expansion replacing GMm. There is no dependence of GMm. Note that $\hbar_{gr} \geq h$ requires $GMm \geq v_0$.

$v_0 \simeq 2^{-11}$ suggested by the Nottale's Bohr orbit model for inner planets and is consistent with the model for the fountain effect of superfluidity [12]. Indeed, the gravitational Compton length of the superfluid particle is $GM/v_0 \simeq 10$ m, which makes sense.

However, the model has a problem. For $M = M_E$, the cyclotron energies $\hbar_{gr}eB_{end}/m$ of dark ions in the endogenous magnetic field $B_{end} = 2/5B_E = .2$ Gauss explaining the findings of Blackman [4] in terms of the $h_{eff} = nh_0 = h_{gr}$ hypothesis would be given by $E_c = GM_E/v_0 \times ZeB_{end}$ and would not depend on the mass m of the charged particle. For $\beta_0 \simeq 2^{-11}$ E_c would be in keV range and 3-4 orders of magnitude above visible range. Biophoton energies are however in visible and UV range.

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1.1 Three ways to solve the problem of the too large cyclotron energy scale

One can imagine several ways to solve the problem of the too large cyclotron energy scale.

1. The dark mass M_D is by 3-4 orders of magnitude smaller than the mass M_E of Earth. Here one should be able to understand why dark particles couple only to a part of M_E.

2. Gravitational constant G_D for dark mass is by 3-4 orders of magnitude smaller than G. This would mean a violation of Equivalence Principle (EP). In the TGD framework, G indeed follows as a prediction and might vary [11]. This could also provide an alternative explanation for the fountain effect.

3. The velocity parameter $\beta_0 = v_0/c \leq 1$ has the value $\beta_0 = 1$ or is near to but below this value. For instance $\beta_0 = 1/2$ is enough. This option is favored by the Nottale's Bohr orbit model of the planetary system. The outer planets β_0 indeed varies: one has $\beta_0(outer) = \beta_0(inner)/5$. One has also $M = M_D$ and $G = G_D$.

1.1.1 Can dark mass M_D be smaller than the total mass M?

The model [8] for the effects of ELF radiation on vertebrate brain [4] led to a generalization of Nottale's hypothesis by replacing the total mass M in the case of Earth by $M_D \simeq 10^{-4}M_E$ suggesting that in this case the dark particles involved couple only to a part of mass identifiable as dark mass M_D.

A possible interpretation is that at long distance from mass M the flux tubes fused to larger flux tubes and the gravitational mass M_D interacting with the test particle increases to M at large distances. This might be in conflict with known facts.

The dark mass M_D appearing in the gravitational Planck constant $h_{eff} = h_{gr} = GM_Dm/v_0$ must at short distances depend approximately linearly on the distance between the masses M_D and m . In the average sense. M_D would depend linearly on distance r. This is required by the condition that the Bohr radii correspond to the classical radii in the average sense. The actual dependence of M_D on r is expected to be a staircase like function.

At the quantum level, this effectively eliminates the average gravitational force in scales below the critical radius r_{cr} above which $M_D = M$ is true. Indeed, due to the average $M_D \propto r$ dependence, gravitational potential would be constant on the average. Could one regard this effective elimination of the gravitational force as a kind of Quantum EP or as an analog of asymptotic freedom?

1.1.2 Could the value of G be reduced to $G_D < G$?

The reduction of $\hbar_{gr}$ could be also due to the reduction G to G_D. This is because only the parameter GM appears in the basic formulas.

1. In the TGD framework Planck length as a fundamental length is replaced by CP_2 length R and Planck length or rather, Newton's constant G follows as a prediction. One can write

$$G = \frac{\hbar_{gr}\beta_0}{Mm} \quad .$$

2. In the number theoretic vision about h_{eff} one can identify $\hbar_{gr}$ as the dimension of the Galois group of an extension of rationals [16]. Since one has in the general case extension of extension of ...of rationals, one has a factorization $\hbar_{gr}/h_0 = \prod_i n_i$ where n_i are dimensions of extensions of extensions in the sequence.

   This suggests that Mm corresponds to an integer in suitable units, say CP_2 length $R \simeq 10^{3.5}m_{Pl}$ and β_0 could also correspond to inverse of integer. $\hbar_{gr}$ would correspond to an integer and the reduction of G to G_D would correspond to a dropping of integer factor from this integer.

3. $\hbar_{gr}$ would factorize to integers assignable to M and m and the integer assignable to G would be reduced in $G \to G_D$. If this integer factorized into a product assignable to M and m characterizing their gravitational couplings, one could understand why the reduction of G occurs only for superfluidity and dark phases in living matter. No additional assumptions about flux tube distribution would be needed.

1.1.3 Does variable β_0 option make sense?

The third option would assume $\beta_0 = 1$ or near to but of order $\beta_0 = 2^{1\,1}$ for the dark ions in living matter. This conforms with the idea that dark dark matter interacts with all matter and satisfies EP.

The value of β_0 could be seen as the property of the dark matter particle and depend on the particle or on the distance from the central object as in the case of the solar system.

Gravitational Compton length l_{gr} Bohr orbit radius a_{gr} are given by $l_{gr} = GM/v_0 = r_S/2v_0$ and $a_{gr} = 2\pi r_S/v_0^2$. The reduction of β_0 scales up the quantum scale considered. Could this give some idea about how the value of β_0 relates to the size scale of the system considered? For the dark ions at magnetic flux tubes the l_{gr} would be about $r_S/2 \simeq .45$ cm, which is a biological scale. Could it correspond to the size scale of some structure of the vertebrate brain, say pineal gland with radius .37 cm?

In the sequel these options will be considered. I try to not take any of these options as a favorite but I must admit that the last option looks the most plausible one - at least now.

2 Could $M_D < M$ make sense?

For the generalization of the Nottale hypothesis discussed in the introduction, the gravitational Planck constant $\hbar_{gr} = GM_D m/v_0$ introduced by Nottale [1] is proportional to dark mass M_D which is in general would be smaller than the entire mass M.

Remark: As noticed in the introduction, it is GM that appears in h_{gr}, so that an alternative option is that G is reduced G_D. It would naturally characterize mass m rather than flux tube. Violation of EP would be in question.

Dark cyclotron energies $E_c = \hbar_{gr} eB_{end}/m = GM_D eB/v_0$ do not depend on the mass of the particle. The condition that the cyclotron frequencies in EEG range correspond to biophoton energy scale in visible and UV range for $B_{end} = .2$ Gauss, gives the estimate $M_D \simeq 2 \times 10^{-4} M_E < M_E$. One proposal is that M_D corresponds to the mass of the inner-inner core of Earth: see the appendix of [17].

This raises the question about how the gravitational flux tubes emanating from mass M and connecting it to small masses m - say elementary particles, atoms of ions - are distributed. At short distances, the entire mass would not be connected to a given mass m by this kind of flux tubes. Does the amount M_D of the mass connected to mass m depend on the distance between m and M? How the allowed values of m are distributed and do they depend on distance? For instance, the condition $GM_D m/v_0 > \hbar$ must be satisfied.

Remark: One can argue that radial magnetic flux tubes are not realistic. One can also consider the possibility that U-shaped flux tubes acting as kind of tentacles in TGD inspired quantum biology, are in question so that magnetic flux would return back. The fusion of flux tubes to larger flux tubes at longer distances makes sense also now.

2.1 Some guide lines

There are several hints, which suggest answers to some of these questions.

1. In the TGD variant [14] of the Bohr model for the planetary orbits [1] around Sun, the dark mass M_D for Sun equals to solar mass: $M_D = M_{Sun}$. This suggests that at large enough distances M_D approaches the total mass M of the object. One can imagine that the flux tubes from M fuse to larger flux tubes so that m experiences $h_{gr} \propto M_{Sun}$ at large distances.

2. In the Bohr orbit model of the planetary system in the gravitational potential of mass M_D, the gravitational binding energy of mass m at the lowest Bohr orbit with $n = 1$ is proportional to $\alpha_{gr}^2 m/2 = mv_0^2/8\pi^2$ ($\alpha_{gr} = v_0/4\pi$) and does not depend on M_D at all. This is true also for higher orbits with $n > 1$.

   The consistency with the classical formula for the potential energy $V_{gr}(r) = GM_D m/r$ suggests that M_D is in average sense proportional to the distance between M and m at small distances.

   The radius r_B of the gravitational Bohr orbit is $r_B = \hbar_{gr}/\alpha_{gr} m = 4\pi GM_D/v_0^2$ and does not depend on m at all (note that $2GM_D$ is the Schwartchild radius associated with M_D). The larger the value of M_D, the larger the distance of m to M. This supports $M_D \propto r$ proportionality at small distances in average sense. There is some distance at which the value of M_D reaches M and does not grow anymore.

These arguments suggest that $M_D \propto r$ holds true in a reasonable approximation and that the gravitational flux tubes from smaller parts of M fuse to form larger flux tubes corresponding to the sum of the masses. A particle at a small distance would experience only part of the gravitational force created by M.

M_D/r would be constant on the average sense below the critical radius R_{cr} at which M_D becomes M and the values of M_D would form a linear staircase. At a given step of the staircase, the value of M_D would be constant and M_D/r would decrease. The radial gravitational force averaged over the staircase would vanish. In the average sense, one would have a free particle in a box.

Taking seriously the identification of M_D at the surface of Earth as the mass of the inner-inner core of the Earth, leads to ask whether the gravitational staircase could correlate with the layered structure of the Earth's interior.

Gravitational force is effectively eliminated below R_{cr}. Could this be interpreted in terms of Quantum EP? Asymptotic freedom is another analogy that pops in mind.

2.2 Magnetospheric sensory representations as a test of the proposal

This proposal can be tested in the TGD based model for sensory representations realized at magnetosphere (MS) [6, 5].

1. The proposal is that the MS of Earth defines sensory representations for the life forms at the surface of Earth. The communication and control would rely on dark photons with energies $E = h_{gr} f$ above thermal energy at physiological temperatures. For energies in visible and UV range dark photons can induce molecular transitions crucial for biochemistry by transforming to ordinary photons identifiable as biophotons [9, 10].

2. The energetic condition should be true near the surface of Earth, inside the rotating inner MS, and also in the outer MS extending to the distance of order $200R_E$. In plasma sheet, the order of magnitude for B is $B \sim 10 - 20$ nTesla. One has $B/B_{end} \sim 5 \times 10^{-4}$ for $B = 10$ nTesla.

3. The cyclotron energies are given by $E_c = GM_D eB/v_0$ and do not depend on m. At the surface of Earth one has $M_D \simeq 2 \times 10^{-4} M_E$. At large enough distances one has $M_D = M_E$. In the outer MS this is expected to be true.

   This would give $E_c(outer) = (M/M_D) \times (B/B_{end}) E_c(Earth) \simeq 2.5 E_c(Earth)$. The cyclotron energies would be of the same order of magnitude as required.

4. Note that the values of v_0 are assumed to the same in inner and outer MS. In the Nottale's Bohr orbit model for the planetary orbits, outer planets and inner planets have different value of v_0: $v_0(outer) = v_0(inner)/5$. This would scale down the gravitational binding energy for outer planets by factor 1/25, which is reasonable. Scaling of v_0 in the case of Earth would increase cyclotron energy scale.

2.3 Critical summary

It must be admitted that I have not been able to develop the generalization of Nottale's hypothesis in a completely satisfactory form and it is best still to summarize the essentials. There is an excruciating uncertainty about the details related to the hypothesis.

1. The hypothesis involves two parameters: $M_D \leq M$ and $\beta_0 = v_0/c$. The integer n labelling the Bohr orbit is an additional parameter. The critical question is whether M_D can really differ from M.

2. Bohr orbit conditions expressing Newton's equation for circular orbit and angular momentum quantization in units of $\hbar_{gr}$ gives for the orbital radius T and velocity v the expressions in terms of the basic parameters.

$$\begin{aligned} R(n) &= n^2 \frac{GM_D}{\beta_0^2} = \frac{GM_D}{v^2} \quad , \\ v &= \frac{\beta_0}{n} \quad , \\ E &= \frac{mv_0^2}{8\pi^2 n^2} \quad . \end{aligned} \tag{2.1}$$

   What is remarkable and perhaps strange looking is that velocity and binding energy are independent of the value of M_D. If one knows the orbital parameters, such as radius and period T one can

One can use various inputs in an attempt to fix the parameters of the model.

1. In the case of the Sun, the radii and the velocities of the orbits of planets provide the information which allows to determine these parameters. $\beta_0(outer) = \beta_0(inner)/5$ relates the inner and outer planets. The value of n and $\beta_0(inner) \simeq 2^{-11}$ are determined by the planetary velocities. $M_D = M$ is implied by the known orbital radii.

2. In the case of Earth there is no analog of planetary data available. The situation should look classical so that the values of n involved are large unlike in the case of Sun.

   If the orbit of a stationary satellite is regarded as a Bohr orbit, one can get an estimate for n. In this case $v = v_0/n$ can be deduced from the period T and radius $R(n)$ of the orbit. For the stationary orbit, one has $R/R_E \simeq 6.62$. Newton's equation gives $GM_D/R = \beta^2$ so that $M_D = M$ must be true. If M_D depends on distance, $M_D \simeq M_E$ must hold true at distance about $6R_E$.

   For $M_D = M$ and $\beta_0 = 2^{-11}$, $\beta = \beta_0/n$ gives $n \simeq 50$. Bohr orbit with Earth radius would have $n \simeq 19$. The reduction of M_D to $2 \times 10^{-4} M_E$ while keeping the radius of the Bohr orbit same, would require $n = 19 \to 1343$.

The above considerations are consistent with $M_D = M$. The hypothesis $M_D \simeq 2 \times 10^{-4} M_D$ deserves a critical discussion.

1. The condition that the cyclotron frequencies in the endogenous magnetic field $B_{end} = .2$ Gauss postulated to explain the findings of Blackman and others correspond to $h_{eff} = h_{gr}$ for which the frequencies at EEG frequency range correspond to the energies in the energy range of biophotons. This gives $M_D \sim 2 \times 10^{-4} M_E$ and the proposed identification is as the mass of the inner-inner core of Earth. Its radius is roughly 5 per cent of the radius of Earth. The model for the fountain effect of super-fluidity is consistent with this estimate of M_D.

2. If M_D really varies, the small masses m cannot couple to the entire mass of (say) Earth: this could be perhaps understood in the flux tube picture in the proposed way.

3 What about the reduction of G to G_D?

As noticed in the introduction, it is actually the parameter GM_D that appears in Bohr conditions. Could it be G is replaced with G_D and one has $M = M_D$? In TGD the value of G indeed comes out as a prediction. CP_2 length R defines the counterpart of Planck length l_P and Newton's constant G is predicted to be $G\hbar = R^2/n_1$, where $n_1 =\sim 10^7$.

One can also write $G = \frac{\hbar_{gr}\beta_0}{Mm}$. Could the value of n_1 increase so that the value of G is reduced to G_D?

1. The condition is that also the new value divides $\hbar_{gr}$ or more precisely, the integer assignable to G in the decomposition of $\hbar_{gr}$ to a product of integers.

2. n_1 has a number theoretic interpretation [11] as a factor of the order of the Galois group assignable to $\hbar_{gr} = n_{gr}h_0$. The variation of n_1 is in principle possible and there is evidence for small variations of G perhaps assignable to that of n_1.

3. The increase of n_1 by a factor about $10^4/2$ is in principle possible: one would have $G_D = 2\times 10^{-4}G$. The new value of n_1 should also divide n_{gr}. This kind of reduction of G for the superfluid phase could also explain the fountain effect as a dramatic weakening of the Earth's gravitation at the gravitational flux tubes connecting Earth to superfluid.

4. Why would not G be reduced for the ordinary matter? It seems that the superfluid-/dark particle property must change the coupling to gravity? The factorization of $\hbar_{gr} = G_D Mm/v_0$ would naturally correspond to the factorization of n_{gr} to a product of factors characterizing masses M, m and the flux tube?

   If $G\hbar$ - when expressed using CP_2 length as unit - factorizes to product of integers assignable to M and m, then the integer associated with m would be reduced so that the reduction of G would characterize the dark particle with mass m.

   Note that also Podkletnov effect [3, 2] discussed from the TGD point of view in [15] suggests a few per cent reduction of G.

5. A geometric interpretation suggests itself [16]. The basic factorization would correspond to a decomposition to $n_{gr} = n_1 n_2$. n_1 would correspond to the number of sheets of space-time surface as a covering of M^4 and n_2 as covering of CP_2: the interpretation as a quantum coherent flux tube bundle of n_2 tubes is suggestive. The values of n_2 would be large and correspond to the factor Mm or Mm/v_0. n_1 would be relatively small and could correspond to G or its factorization to a produce of integers assignable to M and m. This makes sense since the coupling of m to gravitational flux tubes is assumed to be by touching.

To sum up, it seems that one should improve the physical understanding of the Galois group of extension, which in general is extension of extension of ... so that its dimension n is the product of dimensions of extensions involved. Do these dimensions correspond to effective Planck constants assignable to various interactions as suggested in [11]?

4 The option based on variable value of β_0

The motivations for the model with a variable value of $\beta_0 = v_0/c$ have been already explained. In the sequel I will develop a model for the communications between dark matter phases with $h_{eff} = nh_0$ satisfying $h_{eff} = h_{gr}$.

One can consider two options for the communications depending on whether the value of h_{eff} changes as (for instance) in the communications between dark and ordinary matter or whether it is preserved.

1. If the value of h_{eff} can change, energy conservation for $E = h_{eff}f$ allows energy resonance whereas the frequency changes. The simplest option is that the dark photon transforms to say ordinary photon with the same amplitude

2. If the value h_{eff} is preserved, one has both energy and frequency resonance. In the case of cyclotron radiation, the simultaneous occurrence of energy and frequency resonances poses strong conditions on the values of the magnetic fields, the values of charged particle masses, and the parameter β_0 at the ends of the communication line.

4.1 Conditions for frequency - and energy resonance

The condition that the frequency is the same at both ends implies for cyclotron frequencies $f_c = ZeB/2\pi m$ the condition

$$\frac{Z_1B_1}{m_1} = \frac{Z_2B_2}{m_2} \quad . \tag{4.1}$$

For $h_{eff} = h_{gr}$ the condition that the cyclotron energy $E_c = GMZeB/v_0$ at both ends is same implies

$$\frac{Z_1B_1}{v_{0,1}} = \frac{Z_2B_2}{v_{0,2}} \quad . \tag{4.2}$$

Together these conditions give

$$\frac{m_1}{m_2} = \frac{Z_1B_1}{Z_2B_2} = \frac{\beta_{0,1}}{\beta_{0,2}} \quad . \tag{4.3}$$

For instance, if the two particles are proton and electron, one obtains

$$\frac{\beta_{0,1}}{\beta_{0,2}} \simeq \frac{m_e}{m_p} \quad .$$

This ratio is is consistent with the values $\beta_{0,2} = 1$ and $\beta_{0,1} = 2^{-11}$ in the accuracy considered. Is this a mere accident?

4.2 Resonance conditions for communications from the Earth's surface to the magnetosphere?

The simplest option is that the interacting particles have the same values of mass and β_0 and magnetic fields are identical. This is achieved if the flux tubes have constant thickness. Whether this is the case is not clear.

However, the idea that the flux tube picture about magnetic fields is locally consistent with the Maxwellian view inspires the question whether also the magnetic field strength at the flux tubes of B_{end} behaves like $B_{end} \propto 1/r^3$ as B_E in dipole approximation behaves.

B_{end} is by flux conservation proportional to $1/S$, where S is the area of the flux tube. sOne would have $S \propto r^3$. The constancy of B_{end}/m would suggest $m \propto 1/r^3$. If the charged particles are ions characterized by the A/Z ratio.

This would suggest that the regions of tubes/sheets in frequency resonance are at distances

$$\frac{r}{r_0} = (\frac{Z}{Z_0})^{-1/3}(\frac{A_0}{A})^{-1/3}$$

for ions Z_0, A_0 at the surface of the Earth. The heaviest ions would be nearest to the surface of Earth. Energy resonance condition

$$\frac{B_{end}(r)}{\beta_{0,2}} = \frac{B_{end}(R_E)}{v_{0,1}}$$

would give the additional condition

$$\frac{\beta_{0,2}}{\beta_{0,1}} = (\frac{R_E}{r})^3 = \frac{Z}{Z_0} \times \frac{A_0}{A} \quad .$$

β_0 would be quantized and would decrease with the distance.

4.3 Magnetosphere as sensory canvas

TGD leads to a model of the "personal" magnetic body (MB) as being associated with the Earth's MS. Different regions of the body and brain would be mapped to regions of the MS, which would give rise to sensory representations at the personal MB [6, 5]. Personal MB, which would have size scale of at least of the Earth's MS, would also control biological body.

1. An interesting finding relates to the values of the magnetic field $B_{end} \simeq 2B_E/5$ (perhaps identifiable as the monopole flux part of B_E) and the value of $B \sim 10$ nT in the magnetotail at the night-side of the Earth.

   One has $B/B_{end} \sim 2^{-11}$ so that for dark proton-dark electron communications between the Earth's surface and this region of outer MS the resonance conditions would be satisfied for $\beta_0 = x$ and $\beta_0 = 2^{-11}x$, where $x < 1$ not far from unity.

2. Could the parameter β_0 characterize particles and act as a tunable control parameter allowing to achieve energy resonance? Also the values of B are tunable by changing the thickness of the flux tubes as a kind of motor action of MB.

This idea can be applied to the h_{eff} preserving communications between biological body and the MS of the Earth.

1. The quantum coherence condition suggests that the communications are optimal when the wavelength of dark photon is larger than the distance considered: $\lambda > r$ or equivalently the frequency satisfies $f \leq c/r$ (one has $c = 1$ in the units used). If the structure of the MS has distances from the Earth's surface below r_{max} then the frequencies $f \leq 1/r_{max}$ are optimal.

2. Given the distance r_{max} and assuming $B = B_{end}$ at the surface of Earth, one obtains for the cyclotron frequencies the condition

   $$f_c = \frac{ZeB_{end}}{2\pi m} \leq \frac{1}{r_{max}} \quad .$$

   For instance, EEG frequency 10 Hz corresponds to 3×10^7 m. The cyclotron frequency of DNA sequence does not depend on its length and composition since DNA has constant charge per unit length. One has $f_c \simeq 1$ Hz so that the corresponding distance is $r = 3 \times 10^8$ m, that is $r = 46.9R_E$.

   Remark: B_{end} probably has a spectrum. Music experiences relies on frequency scale and if the audible frequencies correspond to cyclotron frequencies then eB_{end}/m is variable. This suggests that the spectrum of B_{end} covers at least the range of the audible frequencies spanning roughly 10 octaves [7].

Received April 16, 2021; Accepted June 12, 2021

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