A toy model of the universe based on a large numbers hypothesis inspired by Edward Teller – towards a TOE centered on life phenomenon

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Abstract

In the last century, a small minority of physicists considered a hypothetical binary logarithmic connection between the large and the small constants of physics, which also implies a base-2 power law (Fürth, 1929; Eddington, 1938; Teller, 1948; Salam, 1970; Bastin, 1971; Sirag, 1980, 1983; Sanchez, Kotov and Bizouard, 2009, 2011, 2012; Kritov, 2013]. In this article, I propose a toy model of the universe (**TMU**) that can offer a couple of potential valid updates for the Standard model (**SM**) of particle physics: the main binary logarithm Teller hypothesis (**mbl-TH**) on the large numbers in physics, which is an alternative interpretation of the Dirac's large numbers hypothesis (**DLNH**); the dimensional relativity hypothesis (**DRH**); the electrograviton model (**EGM**) of the hypothetical graviton based on mbl-TH and DRH; a multiple (quantum) G hypothesis (**mGH**) based on a quantum G series (**Gs_q**); a unified scalar function (**F_N**) for all the (running) coupling constants of the four fundamental fields/forces based on a unifying strong-electroweak-gravitational scaling factor (**N_a**); a cyclic closed universe hypothesis (**CCUH**); life as a fundamental (biophysical) field hypothesis (**LFFH**) based on a new generalized concept of fundamental biophysical field/force (**FBF**). This TMU was motivated and created from the author's strong conviction that SM cannot evolve and become a "mature" TOE without fully explaining the existence of life forms (**LFs**).

Keywords: fine structure constant; gravitational coupling constant; Teller's large numbers hypothesis; Dirac's large numbers hypothesis; Standard model of particle physics; a toy-model of the universe; life phenomenon

I. INTRODUCTION

In 1929, the German physicist R. Fürth proposed the adimensional constant $16^{32} = 2^{128}$ as a possible "connector" between the gravity and quantum mechanics constants [**1**].

Arthur Eddington (1937) and Dirac (1937) have remarked the coincidence of the large adimensional numbers in physics which can be reformulated as:

$$\boxed{a / a_{Gv} \cong R_H / r_e \cong N^{1/2} \overset{def.}{\cong} 10^{40}}$$

($a = 1/\alpha \cong 137$ is the inverse of the fine structure constant [**FSC**] at rest $\alpha \overset{def.}{=} \left(k_e q_e^2 / c\right) / \hbar \cong 1/137$; $a_{Gv} \overset{def.}{=} 1/\alpha_{Gv} \cong 3.1 \times 10^{41}$ is the inverse of a variant of the gravitational coupling constant [**GCC**] $\alpha_{Gv} \overset{def.}{=} \left(Gm_p m_e / c\right) / \hbar \cong 1/\left(3.1 \times 10^{41}\right)$;

$R_H \overset{def.}{=} c / H_0 \cong 14.5 \times 10^9 \, light-years$ is the Hubble radius of the observable universe [**OU**], which is a function of the Hubble constant $H_0 \overset{exp.}{\underset{estim.}{\cong}} 67.6 (km/s)/Mpc$;

$r_e \overset{def.}{=} k_e q_e^2 / \left(m_e c^2\right) \cong 2.8 \times 10^{-15} m$ is the classical radius of the electron at rest; $N \overset{exp.}{\underset{estim.}{\cong}} 10^{80}$ is the approximate number of nucleons in OU which can be estimated by astrophysical methods)

In 1938, Arthur Eddington proposed that the number of protons in the entire Universe should be exactly equal to: $N = 136 \times 2^{256} \cong 1.57 \times 10^{79}$ (N was later called the Eddington's number N_{Edd}) and Eddington hypothesized that square root of N_{Edd} should be close to Dirac's big number (which he invoked in his large number hypothesis) such as $\sqrt{N_{Edd}} = \sqrt{136 \times 2^{256}} = \sqrt{136} \times 2^{128} \cong 3.97 \times 10^{39}$. Later on, Eddington changed 136 to 137 (using the new experimental values of α [re]determined in his life time) and(re) insisted that α had to be precisely $1/137$, a fact which attracted irony at that time [**2**]. However, Eddington's statement also implied the adimensional constant 2^{128}, which wasn't given proper attention for the next 10 years. (Kritov, 2013) [**3**]

In 1948, Edward Teller proposed a possible logarithmic connection between α and $Gm_N^2 / (hc) \cong 10^{39}$ of the form $\boxed{\alpha^{-1} \cong \ln\left[Gm_N^2 / (hc)\right]}$.[**4**]

In 1970, Abdul Salam also brought in attention a possible logarithmic connection between α_{Gv} and α.[**5**]

In 1971, Edward Bastin invoked the observation $a_{Gvv} \overset{def.}{=} \hbar / \left(Gm_p^2 / c\right) \overset{estim,}{\cong} 1.7 \times 10^{38} \overset{99\%}{\cong} 2^{127}$ and proposed the derivation of $a = 1/\alpha \cong 137$ from the exponent 127 by summing 127 with its series of digits, such as 127+(1+2+7)=137. [**6**]

In 1980, Saul-Paul Sirag also proposed an alternative interpretation of the binary logarithmic relation between $a = 1/\alpha$ and $a_{Gv} = 1/\alpha_{Gv}$, such as

$$\boxed{\log_2 \left(a_{Gv}\right) = 137.84 \overset{100.58\%}{\cong} a}$$

. (Sirag, 1980, 1983) [**7**].

John D. Barrow and Frank Tipler probably didn't know about Salam's (1970), Bastin's (1971) and Sirag's (1980,

1983) works on this subject, when they wrote in 1986 that: „Edward Teller appears to have been the first who speculate that there may exist a logarithmic relation between the fine structure constant α and the parameter $Gm_N^2/(hc) \cong 10^{39}$ of the form $\boxed{\alpha^{-1} \cong \ln\left[Gm_N^2/(hc)\right]}$ [equation 4.23] (in fact $\alpha^{-1} \cong \ln(3.27 \times 10^{59})$ [corrected estimation] and the formula is too insensitive to be of very much use in predicting exact relations)"[8,9]. (m_N stands for the approximate nucleon [proton/neutron] rest mass)

Regrettably, Barrow and Tipler also ignored Eddington's works on the subject which could have inspired them to analyze the binary logarithm variant $\boxed{\log_2\left[Gm_N^2/(hc)\right]}$ instead of the natural logarithm variant $\ln\left[Gm_N^2/(hc)\right]$.

This paper proposes additional arguments against Barrow and Tipler superficial analysis of this subject and continues the works of all the authors previously cited who "advocated" in the favor of this binary logarithm connection.

The recurrence of 2^{128} and 2^a factors in these (probably just apparent) numerical coincidences suggests that base-2 power law may have a significant role in numerical relations of these physical constants, predicting the existence of a universal scaling factor of nature that may offer an alternative interpretation to Dirac's large numbers hypothesis (**DLNH**), as this TMU tries to argue.

II. THE QUANTUM ELECTRO-GRAVITATIONAL FIELD (EGF)

1. The main binary-logarithm (variant) of the Teller hypothesis (mbl-TH) and its consequences

*1.1. The main binary-logarithm (variant) of the Teller hypothesis (**mbl-TH**)*

Sirag invoked a numerical coincidence based on the reduced Planck constant $\hbar = h/(2\pi)$, the standard Newtonian constant G, the rest mass of a standard nucleon (proton or neutron) $m_N \ (m_p \, or \, m_n)$ which shall be formally defined in this TMU as the geometric mean $m_N = \sqrt{m_p m_n}$, the rest mass of the electron m_e, the proton and neutron beta constants $\beta_p = m_p/m_e$ and $\beta_n = m_n/m_e$ respectively, with the nucleon beta constant β_N also formally defined as the geometric mean $\beta_N = \sqrt{\beta_p \beta_n}$, the speed of light in vacuum c, the Coulomb constant k_e of the electrostatic force/field, the elementary charge q_e, the inverse of FSC at rest $a = 1/\alpha = \hbar/(k_e q_e^2/c) \cong 137.036$ and the inverse of a variant of GCC $a_{Gv} = 1/\alpha_{Gv} = \hbar/(G\beta_N m_e^2/c)$, such as (reformulated):

$$\log_2(a_{Gv}) \cong 137.8 \overset{100.6\%}{\cong} a \cong 1/\alpha \qquad \textbf{(II-1a)}$$

$$a_{Gv} = \hbar/(G\beta_N m_e^2/c) \cong 3.1 \times 10^{41} \overset{174\%}{\cong} 2^a \qquad \textbf{(II-1b)}$$

At first, this TMU brings into attention a new (probably just apparent) coincidence similar to Sirag's observation, which was discovered by the author in 2014 and registered in 2015[1]. This observation excludes the secondary factor β_N from Sirag's coincidence and implies $a = 1/\alpha$ and $a_G = 1/\alpha_G = \hbar/(Gm_e^2/c)$, such as:

$$\log_2\left(\frac{a_G}{2a^{3/2}}\right) \cong 137.0303 \overset{99.996\%}{\cong} a \cong 1/\alpha$$
$$\textbf{(II-2a)}$$

$$a_G = \hbar/(Gm_e^2/c) \cong 1.78 \times 10^{41} \overset{99.61\%}{\cong} 2^a \qquad \textbf{(II-2b)}$$

$$\boxed{a_G \overset{99.61\%}{\cong} 2a^{3/2}2^a} \qquad \textbf{(II-2c)}$$

Given its striking quantitative precision, this TMU proposes this observation to be formulated as a hypothetical equality which was named "the main binary-logarithm (variant) of the Teller hypothesis (**mbl-TH**)": this was formulated in the purpose of (re)defining a new quantum GCC at rest $\boxed{\alpha_{Gq}}$ and its inverse $\boxed{a_{Gq} = 1/\alpha_{Gq}}$ so that:

$$\boxed{\boxed{a_{Gq} \overset{redef.}{=} 2a^{3/2}2^a}} \qquad \textbf{(II-3a) (mbl-TH)}$$

$$\boxed{\boxed{\alpha_{Gq} \overset{redef.}{=} 1/a_{Gq}}} \qquad \textbf{(II-3b)}$$

1.2. The redefinition of FSC and GCC based on mbl-TH and using a common scaling factor

Based on mbl-TH, this TMU proposes a unifying electro-gravitational scaling factor $\boxed{\boxed{N_a \left(\overset{exp.}{\underset{estim.}{=}} 2^{1/\alpha}\right)}}$ $\left(\overset{estim.}{\cong} 1.8 \times 10^{41}\right)$ that can be considered a new (arbitrary) 1st rank adimensional constant of the Standard Model (**SM**) which has a value that can be determined experimentally using the value of α at rest and then defined indirectly as $N_a \overset{exp.}{\underset{def.}{=}} 2^{1/\alpha}$. Measuring the value of α at rest may be considered an essential indirect method to determine this electro-gravitational scaling factor N_a, which can further

[**1**] Included in a document registered at the Romanian Copyright Office (ORDA) with the registration number 2546 / 26.03.2015 (URL: orda.ro/cautare_cerere.aspx?mid=1&rid=1&cerere=2546)

be used to "contract" and redefine both FSC and GCC at rest, such as:

$$\boxed{a \overset{redef.}{=} \log_2\left(N_a\right)} \qquad \textbf{(II-4a)}$$

$$\boxed{\alpha \overset{redef.}{=} 1/a = 1/\log_2\left(N_a\right)} \qquad \textbf{(II-4b)}$$

$$\boxed{a_{Gq} \overset{redef.}{=} 2a^{3/2}N_a} \qquad \textbf{(II-4c)}$$

$$\boxed{\alpha_{Gq} \overset{redef.}{=} 1/a_{Gq} = 1/\left(2a^{3/2}N_a\right)} \qquad \textbf{(II-4d)}$$

1.3. The definition of a new quantum G scalar based on the quantum redefinition of GCC

As a_{Gq} is considered (by mbl-TH) a function of N_a strictly, a hypothetical G quantum scalar G_q (at rest) can also be deducted from N_a using the new ($N_a - based$) definition of a_{Gq}:

$$\hbar/\left(G_q m_e^2/c\right) \overset{def.}{=} a_{Gq} \overset{redef.}{=} 2a^{3/2}N_a \Rightarrow \qquad \textbf{(II-5a)}$$

$$\boxed{G_q \overset{def.}{=} \frac{\hbar c/m_e^2}{2a^{3/2}N_a}} \qquad \textbf{(II-5b)}$$

$$G_q \cong 6.648\times10^{-11}m^3kg^{-1}s^{-2} \overset{99.6\%}{\cong} G \qquad \textbf{(II-5c)}$$

G_q has a value very close to the standard CODATA-2014 experimental G (in vacuum) $G \cong 6.67408(31)\times10^{-11}m^3kg^{-1}s^{-2}$ (with a relative standard uncertainty established as $u_G = 47\,ppm$) and may stand not only for distances $\lambda > 1cm$ (the approximate limit scale of the experimental measurement of G until present) but may also be valid for much smaller distances $\lambda \ll 1cm$), with $\lambda \geq D_N$: $D_N \cong 1.74\times10^{-15}m$ is the approximate diameter of the low energy [quasi-spherical] nucleon [proton/neutron], a size scale at which the strong nuclear field/force (**SNF**), the weak nuclear field/force (**WNF**), the electromagnetic field/force (EMF) and a possible additional strong gravity field/force (**SGF**) (may) all manifest. However, this TMU considers G_q to be only the lower bound of the real quantum $G \geq G_q$ which may vary with different factors, as explained later by the multiple G hypothesis (**mGH**) (which proposes a general quantum G series for all the chemical elements, including all the isotopes) and by the dimensional relativity hypothesis (**DRH**) (which proposes a general quantum G function for any dimensional frame of reference).

*1.4. The electrograviton model (**EGM**) of the hypothetical graviton based on a gravitational Planck-like constant*

The (electrostatic/electromagnetic) Coulomb constant k_e can be considered an indirect measure of the EMF quanta (measured by h, which has a value determined experimentally), so that $\boxed{k_e \overset{redef.}{=} f\left(h\right) \overset{redef.}{=} k_C \cdot h}$, with $\boxed{k_C \overset{def.}{=} \left(c/q_e^2\right)/\left(2\pi a\right)}$: the energy quanta of the photon with a frequency ν and a wavelength λ is defined as $E_{ph}\left(\nu\right) \overset{def.}{=} h\nu$ and $E_{ph}\left(\lambda\right) \overset{def.}{=} hc/\lambda$ respectively. Analogously, the quantum G scalar G_q can also be considered an indirect measure of the gravitational force/field (**GF**) quanta (measured by a hypothetical gravitational Planck-like constant named h_{eg}) and can be defined in exact numerical analogy to $k_e\left[\overset{redef.}{=} f(h) \overset{redef.}{=} k_C \cdot h\right]$, using an equivalent constant $\boxed{k_G \overset{def.}{=} \left(c/m_e^2\right)/\left(2\pi a\right)}$ and $\boxed{h_{eg} \overset{def.}{=} G_q/k_G}$ so that $\boxed{G_q \overset{redef.}{=} f\left(h_{eg}\right) \overset{redef.}{=} k_G \cdot h_{eg}}$. It results a very small gravitational Planck-like constant $\boxed{h_{eg} \overset{def.}{=} G_q/k_G = h/\left(2a^{1/2}N_a\right)} \Leftrightarrow \boxed{h_{eg} \overset{def.}{=} h/\left(a_{Gq}/a\right)}$, $\boxed{h_{eg} \cong 1.58\times10^{-76}Js}$. The ratio that relates h and h_{eg} can be named *the electrogravitational constant* $\boxed{K_{eg} \overset{def.}{=} h/h_{eg}\left[= a_{Gq}/a = 2a^{1/2}N_a\right] \cong 4.18\times10^{42}}$, $\boxed{K_{eg} \overset{co-def.}{=} \left(k_e/G_q\right)\cdot\left(q_e/m_e\right)^2}$, as it interrelates both the EMF and GF (angular) momentum quanta. The hypothetical graviton defined analogously to the photon (by using h_{eg}) can be named *electrograviton (eg)*. The eg is defined as a hypothetical spin-2 boson (like the graviton) similar to the photon, with a speed equal or very close to c, but with a very small angular momentum quanta $\boxed{h_{eg} \ll h}$. The energy quanta of the eg with a frequency ν and a wavelength λ is defined as $E_{eg}\left(\nu\right) \overset{def.}{=} h_{eg}\nu$ and $E_{eg}\left(\lambda\right) \overset{def.}{=} h_{eg}c/\lambda$ respectively. The gravitational field/force quantized by h_{eg} may be called the electro-gravitational field/force (**EGF**).

2. A hypothesis on the relative number of dimensions as scaled by the electro-gravitational scaling factor N_a: the dimensional relativity hypothesis (DRH)

An interesting (probably just apparent) coincidence emerges when comparing h_{eg} and h with a global momentum parameter of the observable universe (**OU**) at rest, which is measured using angular momentum (L) units $(Joule \cdot s\,[Js])$: $\quad L_U \overset{def.}{=} E_U \cdot t_U \overset{estim.}{\cong} 1.21 \times 10^{89}\,Js$

($E_U \overset{exp.}{\underset{estim.}{\cong}} 2.77 \times 10^{71}\,J$ is the resting energy of OU determined from the experimental measurements of the average energy density of OU (ρ_U) which is estimated to be very close to the critical energy density established by the Friedmann model as $\rho_{Ec} \overset{def.}{=} 3H_0^{\,2}/\left(8\pi G/c^2\right)$ so that $\rho_U \overset{exp.}{\underset{estim.}{\cong}} \rho_{Ec} \cong 7.72 \times 10^{-10}\,J/m^3$ and the volume of OU $V_U \overset{def.}{=} \left(4\pi/3\right)R_U^{\,3} \overset{estim.}{\cong} 3.6 \times 10^{80}\,m^3$ based on the radius of OU $R_U \overset{exp.}{\underset{estim.}{\cong}} 4.4 \times 10^{26}\,m$; $t_U \overset{exp.}{\underset{estim.}{\cong}} 13.8 \times 10^9\,years$ is the age of the present OU, as determined by specific astrophysical methods).

$$d_h \overset{def.}{=} \log_2\left(L_U/h\right)/a \overset{estim.}{\cong} 2.96 \Leftrightarrow L_U/h = N_a^{\,d\cong 3} \quad \textbf{(I-6a)}$$

$$d_{eg} \overset{def.}{=} \log_2\left(L_U/h_{eg}\right)/a \overset{estim.}{\cong} 3.99 \Leftrightarrow L_U/h_{eg} = N_a^{\,d\cong 4} \quad \textbf{(I-6b)}$$

The closeness of d_h and d_{eg} to the integers 3 and 4 respectively (denoting the number of apparent dimensions of space alone and spacetime respectively, as gravity is modeled by General Relativity [**GR**] in a 4D Minkowski space) may suggest that the number of dimensions of OU may not be absolute, so that it may not be correct to predefine the number of dimensions of space/spacetime as pure observational arbitrary parameters without also considering the type of gauge boson (photon, electrograviton etc. and its specific momentum quanta h, h$_{eg}$ etc.) used to measure that number of dimensions d. An arbitrary number of dimensions d_x may be extracted from an arbitrary triad $\left(L_x, N_x, h_x\right)$ as $d_x \overset{def.}{=} \log_2\left(L_x/h_x\right)/\log_2\left(N_x\right)$: this suggests that if may not be correct to define d_x a priori, based only on empirical/experimental observation, without also defining the triad $\left(L_x, N_x, h_x\right)$ from which this d_x was extracted: as a fixed value for d_x (as physics associates space with a 3D reference frame) also implies a fixed value for all the elements of the triad $\left(L_x, N_x, h_x\right)$

*Instead, this TMU launches the dimensional relativity hypothesis (**DRH**) which states that the dimensions (D) of our OU may not be Euclidean but fractal and that the number of dimensions of our OU (d) may not be absolute but relative, depending on the electrogravitational scaling factor N_a and the angular momentum "key"-quanta we use to study the global angular momentum of OU L_U (using our mind, senses and tool-extensions).*

As we generally use the photon to perceive and study space, the fact that $L_U \overset{obs.}{=} hN_a^{\,d\cong 3}$ may generate the "3(a)D-space" appearance: there are also studies which show that time may not exist at the quantum level. The fact that we perceive time at the macroscopically level (as part of an apparent 4(a)D spacetime, with a 4th dimension modeled and measured using a classical linear time function) may be an appearance generated by gravity, and more specific to the EGF angular momentum quanta and to the fact that $L_U \overset{obs.}{=} h_{eg}N_a^{\,d\cong 4}$. The relative largeness of the electro-gravitational scaling factor $N_a \overset{def.}{\cong} 10^{41}$ may (inversely) explain the hierarchy problem (the "weakness" of gravity measured by the large ratio between EMF and EGF momentum quanta) by generating a large electro-gravitational constant defined as $K_{eg} \overset{def.}{=} h/h_{eg}\left[= 2a^{1/2}N_a\right] \cong 4.18 \times 10^{42}$, with $a \overset{redef.}{=} \log_2\left(N_a\right)$: the small $h_{eg} \overset{def}{=} h/K_{eg}$ and the ratio $d_{eg} \overset{def.}{=} \log_2\left(L_U/h_{eg}\right) \cong 3.99a$ may also explain the appearance of a 4th (relative) dimension (measured as classical linear time) when studying the macroscopic world using the small momentum quanta h_{eg} of EGF.

DRH offers a new prediction: the apparent number of dimensions d_x of OU is a function of the triad $\left(L_U, N_a, h_x\right)$ and $a \overset{redef.}{=} \log_2\left(N_a\right)$, especially of the momentum quanta h_x (from this triad) used to study OU, so that:

$$\boxed{d\left(h_x\right) \overset{def.}{=} \log_2\left(L_U/h_x\right)/a \overset{def.}{=} \log_{N_a}\left(L_U/h_x\right)} \quad \textbf{(II-7a)}$$

The human brain uses photons to observe an apparent "empty" space, so that it may be the "victim" of the illusion governed by $d_h \overset{def.}{=} d\left(h\right) = \log_{N_a}\left(L_U/h\right) \cong 3$, which generates the appearance of a 3(a)D spacetime. The human brain uses a combination of photons and gravity (quantized by egs) to observe the movements of objects in space, so that it may be also the "victim" of the illusion governed by $d_{eg} \overset{def}{=} d\left(h_{eg}\right) = \log_{N_a}\left(L_U/h_{eg}\right) \cong 4$, which generates the appearance of a 4(a)D spacetime, with a 4th (temporal) dimension attached to a perceptual 3(a)D space. When we imagine theories that consider quantum objects as being composed of much smaller bits of momentum called strings or branes (like the Super String Theory [**SST**] or M-theory [**MT**] respectively), the human mind may also the "victim" of an illusion governed by $d_{str} \overset{def.}{=} \log_{N_a}\left[L_U/h_{str}(\ll h_{eg})\right] \to \left(d \geq 5\right)$.

This hypothesis can also offer an escape from a potential tautology, as when we measure different parameters of a quantum particle (**QP**), we use algorithms and equations based on the a priori assumption that space has 3 dimensions (d=3), which may be essentially an illusion created by the ratio $d_h \overset{def.}{=} \log_2\left(L_U/h\right)/a \cong 3$.

Based on the DRH main assumption that dimensions are relative, the d(a)D dimension will be shortly named dD dimension (3D, 4D etc.), for the simplicity of formulations.

In the view of DRH, any QP may be both elementary or composite, depending on the frame of observation defined by the triad $\left(L_x, N_x, h_x\right)$. This hypothesis proposes a fractal OU that permits potential infinite "zooming" in/out (as d_x may also have negative value for imaginary $h_x > L_U$), and potential infinite detail: as it may show (almost) infinite complexity (as it may be [almost] infinitely divisible / scalable using N_a). For example, in a 5D frame defined by the triad $\left(L_U, N_a, h_{str}\right)$, the string appears as the only "elementary" physical entity (and all the other known quantum particles [including the electrograviton] are composed of these 5D-frame associated strings); in a d>5D frame, even the strings may appear as composite and so on.

Additionally, the 2D frame (which is equivalent to a hypothetical 1(A)D frame with $A = 2a$ and $N_A = N_a{}^2$, with $A = \log_2\left(N_A\right)$) appears to be an important "attractor" for all the rest energies $E_{rest} \overset{def.}{=} m_{rest}c^2$ of the main stable quantum particles when related to E_U and expressed in dimensional a-units/A-units, which also sustains Gerard 't Hooft's holographic principle:

Table II-1. The 2D frame of the main stable quantum particles

nucleon	$\log_2\left(E_U/E_N\right) \cong 1.99a \cong 0.99A$
electron	$\log_2\left(E_U/E_e\right) \cong 2.06a \cong 1.03A$
up-quark	$\log_2\left(E_U/E_{qu}\right) \cong 2.05a \cong 1.025A$
down-quark	$\log_2\left(E_U/E_{qd}\right) \cong 2.04a \cong 1.02A$

The same QPs appear both as 2(a)D branes in a 4(a)D universe or as 1(A)D branes (strings) in a 2(A)D (holographic) universe: SST and MT rely on this second simplified dimensional view, which is based on A-units.

Inversely, based on the definition $d_x \overset{def.}{=} \log_{N_a}\left(L_U/h_x\right)$, this TMU also defines a specific momentum quanta associated to any frame with a number of d dimensions such as $\boxed{hf\left(d\right) \overset{def.}{=} L_U/N_a{}^d}$. Based on the $hf\left(d\right)$ function, DRH predicts and defines a quantum G function Gf_q associated to any integer/fractional dimensional frame with d dimensions, such as: $\boxed{Gf_q\left(d\right) \overset{def.}{=} k_G \cdot hf\left(d\right) = k_G \cdot L_U/N_a{}^d}$, with $G_q \overset{obs.}{\cong} Gf_q\left(4\right) \overset{exp.}{\underset{obs.}{\cong}} G$.

Based on the $Gf_q\left(d\right)$ general definition, DRH predicts a hypothetical (very plausible) strong gravity constant (**SGC**) associated with the 3D frame and generated by a strong gravity field (**SGF**) measured by a momentum quanta close to $hf\left(3\right) \cong h$, such as:

$$\boxed{\overset{def.}{\underset{obs.}{\Gamma}} \cong Gf_q\left(3\right) \cong 10^{31}m^3kg^{-1}s^{-2}}, \qquad \boxed{\overset{estim.}{\Gamma} \cong 1.5 \times 10^{41}G}.$$

The majority of authors have calculated a value for Γ from $\Gamma_{inf} \cong 10^{25}m^3kg^{-1}s^{-2}$ (which corresponds to $d_{inf} \cong 2.84$) to $\Gamma_{sup} \cong 10^{37}m^3kg^{-1}s^{-2}$ (which corresponds to $d_{sup} \cong 3.14$), with most of estimations between $10^{28}m^3kg^{-1}s^{-2}$ and $10^{32}m^3kg^{-1}s^{-2}$, with $d_{average} \cong 3$. (Seshavatharam and Lakshminarayana S. , 2010, 2012, 2015 [**10,11,12**]; Perng, 1978 [**13**]; Fisenko et al., 2006, 2008, 2010 [**14,15,16**]; Recami et al., 1994, 1995, 1997-2001, 2005 [**17,18,19**]; Fedosin, 1999, 2009, 2012, 2014 [**20,21,22**]; Tennakone, 1974 [**23**]; Stone, 2010 [**24**]; Oldershaw, 2007, 2010 [**25,26**]; Mongan, 2007-2011[**27**]; Sivaram and Sinha, 1977 [**28**]; Dufour, 2007 [**29**])

A SGF with a strength measured by $\overset{def.}{\Gamma} \cong 1.5 \times 10^{41}G \gg G$ may also explain the anomaly $\overset{obs.}{\cong}\left(-3.4\right)\%$ from the MUon proton Scattering Experiment (MUSE) in the measurement of the proton charge radius r_p by using the muon (resulting an $r_{p(m)} \cong 0.84\,fm$) instead of the electron (resulting an $r_{p(e)} \cong 0.87\,fm$) [**30**]: at atomic and/or nucleonic scales SGF may compress the proton charge (implicitly lowering its volume and radius) in the case of the muon (which is $\overset{obs.}{\cong} 207$ times heavier than the electron and which also may generate a SGF measured by $\overset{def.}{\Gamma} \gg G$). Based on this hypothetical explanation, this TMU proposes that the real proton charge radius r_p to be defined as that determined by using the electron (which doesn't compress that radius significantly by a potential SGF), so that $r_p = r_{p(e)} \cong 0.87\,fm$.

Furthermore, DRH also predicts that there may exist a set of very strong gravity fields (VSGF) associated to the 2D, 1D and 0D frame respectively which may manifest at scales progressively closer to the Planck length scale, such as: $Gf_q\left(2\right) \cong 10^{72}m^3kg^{-1}s^{-2} \cong 10^{82}G$,

$Gf_q\left(1\right) \cong 10^{113}m^3kg^{-1}s^{-2} \cong 10^{123}G$ and

$Gf_q\left(0\right) \cong 10^{155}m^3kg^{-1}s^{-2} \cong 10^{165}G$ ($Gf_q\left(0\right)$ *is a potential candidate for the upper bound of plausible finite G that limits the growth to infinity of the strength of gravity when approaching infinitesimal length scales as in the black holes and inferior to the Planck length scale: the predicted so-called asymptotical freedom of gravity*)

Using DRH, this TMU proposes the generalization of EGM so that $\boxed{hf_{eg}\left(d\right) \overset{def.}{=} L_U/N_a{}^d}$ which generates the

function $Gf_q(d) \overset{def.}{=} k_G \cdot hf_{eg}(d)$. In this view, the Newtonian/relativistic gravity is mediated by the 4D-frame electrograviton, with an angular momentum quanta measured by $h_{eg} \cong hf_{eg}(4)$ which generates $G \overset{obs.}{\cong} Gf_q(4)$. In the same view, SGF is mediated by the 3D-frame electrograviton with $hf_{eg}(3) \cong h$, which has a strength also measured by $\boxed{\Gamma \overset{def.}{\underset{obs.}{\cong}} Gf_q(3) \cong 1.5 \times 10^{41} G}$.

The DRH-based SGF may co-predict the existence of the Higgs field (**HF**), as the 3D-frame eg has some striking scalar similarities with the Higgs boson (**HB**), which is a scalar QP (the only known scalar QP in nature, first predicted to exist in 1960s) with 0-spin and even parity. HB is defined as the quantum excitation of one [of the four] components of HF: HB is a very plausible candidate for the 3D-frame eg (predicted by DRH) and vice versa, as also $\boxed{d(h_{Hig}) \overset{estim.}{\cong}}$ $\boxed{2.87(\cong 3) \cong d(h)}$, with $\boxed{h_{Hig} \overset{def.}{=} E_{Hig} \cdot t_{Hig}}$, $\boxed{h_{Hig} \overset{estim.}{\cong} (4718.5)h}$ ($E_{Hig} \overset{def.}{=} m_{Hig} \cdot c^2$ is the rest energy of the Higgs boson; $m_{Hig} \overset{pred.}{\underset{exp.}{\cong}} 125 GeV$ is the predicted and confirmed rest mass of the Higgs boson; $t_{Hig} \overset{pred.}{\underset{exp.}{\cong}} 1.56 \times 10^{-22} s$ is the mean lifetime of the Higgs boson). This DRH sub-hypothesis also implies that $\boxed{Gf_q[d(h_{Hig})] \overset{estim.}{\cong} Gf_q(3) \cong \Gamma}$. However, the mainstream considers that more studies are needed to firmly confirm if the ~125GeV boson discovered in CERN's Large Hadron Collider (**LHC**) has properties matching those predicted by SM for HB, or whether, more than one type of HB exist (as predicted by some theories). The 100% confirmation of HF existence depends on the final confirmation of HB existence, as HF is detected through its excitations (the HBs, which are difficult to obtain and detect).

HF is predicted to be tachyonic (symmetry-breaking of HB [through condensation] only occurs under certain conditions), and has a "Mexican hat" shaped potential with non-0 strength at any distance (also manifesting in empty space and permeating the entire OU and possibly all the real universe [RU]), similar to both EMF and the predicted SGF.

In its vacuum state, HF breaks the weak isospin symmetry of the electroweak field (**EWF**) and generates the W and Z bosons of WNF, which have very large non-0 rest masses of about (80-90)GeV. HF may also explain the non-0 rest masses of other elementary QPs like quarks and leptons (that are predicted to be normally massless when considering the symmetries controlling their interactions), by using other HF-based mechanisms alternative to the Higgs mechanism (**HM**).

As a potential candidate for SGF, HF may also explain the proton charge radius anomaly of determined by MUSE, as previously explained.

DRH considers very plausible the possibility that the symmetry-breaking condensation of HB to also generate 4D-frame egs, which mediated the EGF: this implies EGF to be a residual SGF, and may contribute to the N_a-based explanation of the hierarchy problem, as $\boxed{Gf_q[d(h_{Hig})]/Gf_4(3) \overset{estim.}{\cong} N_a}$ (with an approximate same order of magnitude)

DRH also predicts that VSGFs are probably mediated by the 0/1/2D-frame egs quantized by $hf_{eg}(0/1/2)$ which generates $Gf_q(0/1/2)$ and may also have 0-spin and even parity (like HB and the 3D-frame eg).

In conclusion, DRH (as based on the universal scaling factor N_a) offers important explanations and predictions (mainly the generalization of the electrograviton model for any relative frame with d(a)-dimensions)

3. An electro-gravitational Planck-like series scalar hs_{eg} and a quantum G series scalar Gs_q, both defined as functions of the average nuclear binding energy per nucleon (E_{BN})

Based on EGM, this TMU also proposes an alternative plausible explanation to the apparent paradox of the divergent variation of experimental G values, „despite" constant improvements in the measurement systems [**31,32**]: CODATA-1999 decided to officially increase the relative standard uncertainty of G (u_G) from 128 ppm to 1500 ppm; CODATA-2010 (re-) established an $u_G = 120 ppm$. The experimental G values differ from one another by a G-value deviation d_G as much as $d_G \cong 450 ppm$, even though most of them have $d_G \cong 40 ppm$: that is why CODATA-2014 established that $u_G \cong 47 ppm$. However, despite all these previous facts, some reputable research teams still report $d_G \cong 240 ppm$ in the last decade [**33**].

The average nuclear binding energy per nucleon (E_{BN}) from any (quasi/)stable nucleus of any isotope is an intranuclear energetic „pressure" that may modify the EGF quanta (measured by h_{eg}) of the gravitational field generated by each of those nucleons. This TMU launches the hypothesis that h_{eg} may vary with a simple grade-I function that generates a $hs_{eg}(E_{BN})$ series for any (quasi/)stable isotope nucleus. As $G_q \overset{def.}{=} f(h_{eg}) = k_G \cdot h_{eg}$, the variability of the experimental G values may be explained by the variability of the $hs_{eg}(E_{BN})$ values: that is why this TMU proposes a quantum G series $Gs_q(E_{BN}) \overset{def.}{=} f(hs_{eg}) = k_G \cdot hs_{eg}(E_{BN})$, which implies that each chemical isotope may have its own quantum G „imprint".

$$\boxed{hs_{eg}(E_{BN}) \overset{def.}{\underset{pred.}{=}} h_{eg} \cdot \left(1 + \frac{E_{BN}}{m_N c^2}\right)}, \qquad \textbf{(II-7a)}$$

with a formal definition $m_N \overset{def.}{=} \sqrt{m_p \cdot m_n}$

$$\boxed{\boxed{Gs_q\left(E_{BN}\right) \underset{pred.}{\overset{def.}{=}} f\left(hs_{eg}\right) = k_G \cdot hs_{eg}\left(E_{BN}\right)}} \qquad \textbf{(II-7b)}$$

This TMU also considers that experimental G (as measured between two atoms/isotopes [a_1 and a_2]) is in fact an indirect measure of the combined quanta of two superposing EG fields generated mainly by the two nuclei of the two isotopes, each characterized by its own quanta $hs_{eg}\left(E_{BN(1)}\right)$, $hs_{eg}\left(E_{BN(2)}\right)$ and (implicitly) by its own quantum G scalar $Gs_q\left(E_{BN(1)}\right)$ and $Gs_q\left(E_{BN(2)}\right)$. Measuring G experimentally may be in fact measuring the resulting $Gs_q\left(E_{BN(1,2)}\right)$ scalar that can be (hypothetically) defined as a simple (empirical) geometric mean of $Gs_q\left(E_{BN(1)}\right)$ and $Gs_q\left(E_{BN(2)}\right)$, such as:

$$\boxed{Gs_q\left(E_{BN(1,2)}\right) \overset{def.}{=} \sqrt{Gs_q\left(E_{BN(1)}\right) \cdot Gs_q\left(E_{BN(2)}\right)}} \qquad \textbf{(II-7c)}$$

$$(\text{experimental})G \overset{pred.}{\equiv} Gs_q\left(E_{BN(1,2)}\right) \qquad \textbf{(II-7d)}$$

The $Gs_q\left(E_{BN}\right)$ function can aproximate Sun's and Earth's specific (average) Gs_q value based on their chemical composition. The Sun is predominantly composed from hydrogen (H) gas (>70% of the Sun's mass, predominantly represented by the protium ^1H isotope) [34] and ^1H has a specific $Gs_q\left(E_{BN(^1H)}\right) = Gs_q\left(0MeV\right) = G_q \cong \left(99.6\%\right)G$: that is why one can estimate the Sun's specific average $Gs_{q[SUN]} \cong G_q \cong \left(99.6\%\right)G$. The main chemical element in the composition of the Earth (litosphere and crust) is the oxygen (O) (>30% of litosphere and crust masses, predominantly represented [99.762%] by the isotope ^{16}O)[35] and O is a chemical element with a specific $Gs_q\left(E_{BN(^{16}O)}\right) = Gs_q\left(7.98MeV\right) \cong \left(100.46\%\right)G$. It is very possible that:

(**1**) (prediction) If experiments on G will be conducted into space, the G values will tend to be smaller (due to the influence of the Sun's specific EGF, which is quantified by $hs_{eg}\left(E_{BN(^1H)}\right) = h_{eg}$ and $Gs_q\left(E_{BN(^1H)}\right)$) and due to the masive flow of egs (with specific $hs_{eg}\left(E_{BN(^1H)}\right) = h_{eg}$) emitted towards the Earth , egs that may "contaminate"/influence the experiments conducted on Earth.

(**2**) (retrodiction) When the experiments are conducted deep in the Earth's layers (usually in deep mines) they tend to generate larger experimental G values corresponding to $Gs_q\left(E_{BN(^{16}O)}\right) \cong \left(100.46\%\right)G$: this second statement is an already confirmed retrodiction, as the experiments on G conducted at depths generated systematically high(er) values of G. [36,37]

(**3**) As the „mix" of EGF fields of the Sun, Earth and other astronomical physical systems also depend on the reciprocal spatial orientation of these PSs, this TMU also predicts that the experimental values of G can additionally depend on: (**a**) the Earth's altitude and latitude at which the experiment takes place; (**b**) The Sun, the momentary distance/configuration between Earth and other stars; (**c**) the chemical composition of that specific Earth region in which the experiment takes place. In 2002, Mikhail Gershteyn and his colleagues have successfully demonstrated experimentally that the G of the F_g vector (the gravitational force established between two test bodies) varies with their orientation in space, relative to a system of distant stars [**38**]. At the present, experimental measurements of G have the potential to better differentiate between different (combined) chemical structures G „imprints" and between different Sun-Earth-stars configurations G „imprints".

This multiple-G hypothesis (mGH) is verifiable both retrospectively (by analyzing the negative/positive altitude/latitude, the Sun/Stas-Earth configuration, the chemical composition of that region and of all the materials[**39**] used in past 200 years G determination experiments) and in the future by using the same experimental device at different altitudes/latitudes [**40,41,42**] and in different regions and using metal spheres of different atoms or single various atoms and then analyze the systematic differences [**43**] between the experimental G as a function of all these physical and chemical variables: Gundlach's and Merkowitz's method [**44**] and *atom inferometry using cold atoms* [**45,46**] are two very useful new tools in this direction.

As it can be seen in the next figure, the theoretical series $Gs_q\left(E_{BN}\right)$ tends to approximate all the experimental measurements of G in the past over 200 years [**47,48,49,50,51**] (for simplicity and clarity, the error limits for each determined value of G where not represented in the next graph): $G_{\exp(ascend.)}$ represents the experimental G values in a non-chronological but ascending order, which generates a graph quite similar to the $Gs_q\left(E_{BN}\right)$ graph curve from the same figure. However, all the experimental G values obtained on Earth are „contaminated" by the EGF field of the Sun and the egs received from it, which are all characterized by $hs_{eg}\left(E_{BN(^1H)}\right) = h_{eg}$ and $Gs_q\left(E_{BN(^1H)}\right) \cong \left(99.6\%\right)G$: that is why the graph of the derived series $\left[Gs_q\left(E_{BN(^1H)}\right)/G\right] \times G_q\left(E_{BN}\right)$ is also plotted.
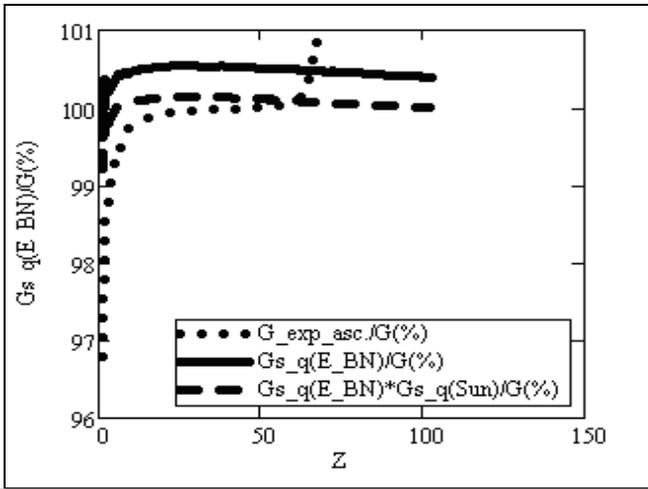
Figure II-1. $Gs_q(E_{BN})$ series (as function of $hs_{eg}(E_{BN})$ series) including $\left[Gs_q\left(E_{BN(^1H)}\right)/G\right] \times G_q(E_{BN})$, both compared to the experimental values of G in a not-chronological but ascending order

It is also important to note that the last portion of the $G_{exp(ascend.)}$ graph (which intersects the other two graphs of $Gs_q(E_{BN})$ and $\left[Gs_q\left(E_{BN(^1H)}\right)/G\right] \times G_q(E_{BN})$) it is relatively superposable to the E_{BN} peaks of ^{4}He, ^{12}C, ^{16}O and ^{56}Fe, peeaks which are to be remarked in the first portions of the $Gs_q(E_{BN})$ graph.

Both $hs_{eg}(E_{BN})$ and $Gs_q(E_{BN}) \overset{def.}{=} f(hs_{eg}) = = k_G \cdot hs_{eg}(E_{BN})$ offer an important potential correlation between QFT and GR: the larger the element X $hs_{eg}(E_{BN(X)})$, the larger the curvature of spacetime, so that the $hs_{eg}(E_{BN})$ may be consideered a stress-energy-momentum tensor at the quantum level. This TMU proposes that G should be replaced with $Gs_q(E_{BN})$ in the Einstein (gravitational) field equations (EFE) of the general relativity (GR): the new emergent quantum EFE may bring GR and QFT closer.

$$G_{\mu\nu} + \Lambda g_{\mu\nu} \overset{pred.}{=} \frac{8\pi Gs_q(E_{BN})}{c^4} T_{\mu\nu} \Leftrightarrow \qquad \textbf{(II-8e)}$$

$$\Leftrightarrow G_{\mu\nu} + \Lambda g_{\mu\nu} \overset{pred.}{=} \frac{(4\alpha) hs_{eg}(E_{BN}) \cdot c}{(m_e c^2)^2} T_{\mu\nu} \qquad \textbf{(II-8f)}$$

Check-point conclusion. The so-called "systematic error" suspected in G measurement may actually be a „systematic" quantum gravity...fact. Not only that mGH proposes a potential significant quantum update for EFE, but mGH is also an important predicition that has the potential to change the paradigm in quantum gravity theory demonstration/verification, as an indirect elegant proof of the existence of the graviton (modelled as „electrograviton") and the validity of the quantum (electro)gravity theory: this right „under our nose" quantum gravity (indirect) proof hidden/masked by the experimental G value relatively high variability can open a new unexpected gate to a TOE that can unify GR with QFT.

4. The prediction of the main global parameters of OU based on electrogravitational scaling factor N_a

As the electrogravitational scaling factor N_a determines both α and α_G at rest, it is expected that N_a can predict (by approximation) both atomic quantities and global macrocosmic quantities (at rest / low energies).

The length $N_a \cdot r_e \cong 5 \times 10^{26} m$ ($r_e = k_e q_e^2 / (m_e c^2)$ $\cong 2.8 \times 10^{-15} m$ is the classical electron radius), has a value which is relatively close to the (experimentally) estimated OU radius $R_U \cong 4.4 \times 10^{26} m$, so that $\boxed{N_a \cdot r_e \overset{pred.}{\cong} 1.14 \cdot R_U}$ and $\boxed{\log_2(R_U / r_e) \cong 136.85 \overset{99.86\%}{\cong} a}$. The same with the length $N_a \cdot r_p \cong 1.5 \times 10^{26} m$ ($r_p \cong 0.84 \times 10^{-15} m$ is the proton radius) which is also relatively close to R_U so that, $\boxed{N_a \cdot r_p \overset{pred.}{\cong} 0.35 \cdot R_U}$ and $\boxed{\log_2(R_U / r_p) \cong 138.57 \overset{101.12\%}{\cong} a}$. Additionally, $c / (N_a \cdot r_p) \overset{pred.}{\cong} 60.54 [(km/s)/Mpc] \overset{89.56\%}{\cong} H_0$ ($H_0 \cong 67.6[(km/s)/Mpc]$ is the Hubble constant as determined by the latest measurements from 2015).

The mass $N_a^2 \cdot m_H \cong 5.34 \times 10^{55} kg$ $\left(with\ m_H = m_p + m_e\right)$ predicts a value which is relatively close (but higher) to the (experimentally) estimated total rest mass of the OU $\left(M_U = E_U / c^2 \cong 3.1 \times 10^{54} kg\right)$, so that $\boxed{N_a^2 \cdot m_H / M_U \overset{pred.}{\cong} 17.32}$. The mass $\left(N_a^2 / a^{1/2}\right) \cdot m_H \cong 4.56 \times 10^{54} kg$ is closer to M_U, but also higher, so that $\boxed{\left(N_a^2 / a^{1/2}\right) \cdot m_H / M_U \overset{pred.}{\cong} 1.48}$.

More interestingly, the constant $\boxed{a^{3/2} N_a^{1/2} \cong 6.78 \times 10^{23}}$ is very close to the numerical value of the Avogadro constant $N_A \cong 6.023 \times 10^{23}$ (number of molecules / mole), so that $\boxed{a^{3/2} N_a^{1/2} \overset{112.58\%}{\cong} N_A}$.

III. THE QUANTUM ELECTROMAGNETIC FIELD (EMF)

1. The scalar function of the running FSC expressed using N_a

According to Quantum Electrodynamics (**QED**), the variation of the EMF running coupling constant α is defined by a function $\alpha f(E)$, which can be calculated by using the beta function $\beta(g) = \partial g / \partial \ln(E)$ that

encodes the dependence of a coupling parameter (g) on the energy scale (E) of a given physical process described by quantum field theory (**QFT**).

Because of the underlying renormalization group, $\beta(g)$ has no direct dependence on E and implicitly only depends on E through g : this "running" of the coupling parameter g with the energy scale (E) is the fundamental feature of scale-dependence in QFT. $\beta(g)$ is explicitly computed using the mathematical methods of the perturbation theory.

The computed $\alpha f(E)$ shows an inversely-proportional variation of α with the length scale λ and a directly-proportional variation of α (by a logarithmic law) with the energy scale $E = E_{ph}(\lambda) = hc/\lambda$ and with the energy scale ratio E/E_0 implicitly, with EMF strength (defined by α) growing and approaching to the SNF strength (defined by the SNF coupling constant α_S) at (very) high energy scales $(very\,high\,E)$: however QED is not well defined as a quantum field theory (**QFT**) for any arbitrary high energy E, because α runs to infinity at a specific finite E (this Landau pole is a quantum triviality that motivates the embedding of QED within a Grand Unified Theory [**GUT**], to solve this issue). The function $\alpha f(E \geq E_0)$ defines the variation of α with the energy scale ratio E/E_0 (with $E = E_{ph}(\lambda) = hc/\lambda$ being the energy scale tested and $E_0 \overset{def.}{\underset{exp.}{\cong}} 10^{-10}\,eV$ being the energy of a very low frequency ν_{VLF} photon with $\nu_{VLF} \cong 30kHz$, $\lambda_{VLF} \cong 10km$ and $E_{ph(0)}(\nu) = h \cdot \nu_{VLF} = h \cdot c/\lambda_{VLF} \cong E_0$: E_0 is the lower bound of the testable energy scale, which conventionally defines the (almost) "rest" state in QED, with $\alpha f(E)$ being valid only above this energy scale E_0), with a value at rest $\alpha f(E_0) = \alpha$ [**52**]

$$\alpha f(E \geq E_0) \overset{exp.}{\cong} \cfrac{1}{a - \cfrac{2\ln(E/E_0)}{3\pi}} \qquad \textbf{(III-1)}$$

As $\alpha \overset{def}{=} 1/a = 1/\log_2(N_a)$ by definition, the function $\alpha f(E \geq E_0)$ can also be considered as derived from an exponential function based on the scaling factor N_a, so that:

$$Nf_a(E \geq E_0) \overset{def.}{=} N_a / (E/E_0)^{\frac{\ln(4)}{3\pi}} \quad \text{and} \qquad \textbf{(III-2a)}$$

$$\alpha f(E_0 \leq E < E_{sup}) \overset{def}{\underset{exp.}{\cong}} 1/\log_2[Nf_a(E)] \qquad \textbf{(III-2b)}$$

In contrast to $\alpha f(E \geq E_0)$, this $Nf_a(E \geq E_0)$ function has finite values for any finite $E \geq E_0$ and doesn't generate infinities, with the mention that it doesn't permit to calculate $\alpha f(E) \overset{def}{\cong} 1/\log_2[Nf_a(E)]$ for

$$E_{sup} \overset{def.}{=} E_0 \cdot N_a^{3\pi/\ln(4)} \cong 2.84 \times 10^{261}\,GeV,$$ which

corresponds to $Nf_a(E_{sup}) = 1$ and $\alpha f(E_{sup}) \overset{def}{\approx} 1/0$ (the Landau pole of $\alpha f(E)$, as division by 0 generates infinity at $\alpha f(E_{sup})$). E_{sup} is over 180 orders of magnitude larger than the rest energy of OU $E_U \overset{exp.}{\cong} 2 \times 10^{81}\,GeV$: E_{sup} may *be an upper bound for the total rest energy of a hypothetical huge-but-finite real universe (as explained in the final chapters of this paper).*
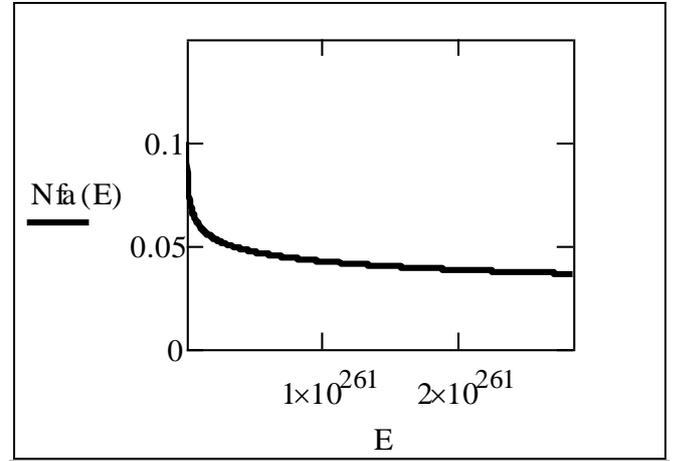

Figure III-1. The graph of $Nf_a(E)$ for $E_0 \leq E(GeV) \leq E_{sup}$

IV. THE QUANTUM STRONG NUCLEAR FIELD (SNF)

1. The scalar function of the SNF running coupling constant as expressed exponentially

a. *The scalar function of the SNF running coupling constant expressed exponentially*

According to Quantum Chromodynamics (QCD), the variation of the SNF running coupling constant α_S can also be defined by a function $\alpha f_S(E)$, which can also be calculated by using the same beta function $\beta(g) = \partial g / \partial \ln(g)$ mentioned for $\alpha f(E)$. $\alpha f_S(E)$ shows a directly-proportional variation of α_S with the length scale λ and an inversely-proportional variation of α_S (by a logarithmic law) with the energy scale

$E = E_{ph}(\lambda) = hc / \lambda$ and the energy scale ratio E / E_{SNF}: the so-called asymptotic freedom of the SNF coupling in QCD (E is the energy scale tested; $E_{SNF} \overset{exp.}{\underset{def.}{\cong}} 210(\pm 40)\,MeV \cong (22\%)(m_p c^2)$ is the experimentally determined energy scale of QCD, a scale below which SNF becomes sufficiently strong to collapse/"freeze" the components of a quark-anti-quark-gluon plasma (composed of separated quarks, anti-quarks and gluons that move freely [asymptotical freedom]) generating the quark-gluon bound states such as pions and nucleons; $n = 6$ is the number of the quark flavors; $\beta_0 \overset{def.}{=} -11 + 2n/3 = -7$ is a specific constant of QCD, based on $n = 6$):

$$\boxed{\begin{aligned} \alpha f_S(E > E_{SNF}) &\overset{exp.}{\cong} \frac{-2\pi}{\beta_0 \cdot \ln(E / E_{SNF})} \Rightarrow \\ \Rightarrow \alpha f_S(E > E_{SNF}) &\overset{exp.}{\cong} \frac{2\pi}{7\ln(E / E_{SNF})}, \\ &\text{valid for } E \gg \sqrt{2}E_{SNF} \end{aligned}}$$

(IV-1)

For the standard value of the proton rest energy scale $E_p \overset{def.}{=} m_p c^2$, $\alpha f_S(E_p) \cong 0.6$ and $\alpha f_S(e \cdot E_p) \cong 0.9$ ($e = \lim_{x \to \infty}(1 + 1/x)^x \cong 2.718$ is the transcendental base of the natural logarithms) [**53**]

Analogously to $Nf_a(E)$ and $\alpha f(E) \overset{def.}{\cong} 1 / \log_2[Nf_a(E)]$, the function $\alpha f_S(E)$ can also be considered as derived from an exponential function $Nf_S(E)$ and $E > E_{SNF}$, so that:

$$\boxed{\boxed{Nf_S(E \geq E_{SNF}) \overset{def.}{=} (E / E_{SNF})^{\frac{7\ln(2)}{2\pi}}}} \text{ and}$$

(IV-2a)

$$\boxed{\boxed{\alpha f_S(E > E_{SNF}) \overset{def}{\underset{exp.}{\cong}} 1 / \log_2[Nf_S(E)]}}$$

(IV-2b)

In contrast to $\alpha f_S(E)$ and similarly to $Nf_a(E)$, the function $Nf_S(E)$ also has finite values for any finite E and doesn't generate infinities, with the mention that it doesn't permit to calculate $\alpha f_S(E > E_{SNF}) \overset{def}{\cong} 1 / \log_2[Nf_S(E)]$ for $E_{inf} = E_{SNF}$, which corresponds to $Nf_S(E_{inf}) = 1$ and $\alpha f_S(E_{inf}) \approx 1/0$ (the Landau pole of $\alpha f_S(E)$, as division by 0 generates infinity for $\alpha f_S(E_{inf})$).

The function $Nf_S(E)$ may be additionally "aligned" to the other $Nf_a(E)$: if we consider $\boxed{k_{SNF} \overset{def.}{=} E_{SNF} / E_0 \cong 2.1 \times 10^{18}}$, then $Nf_S(E)$ can also be rewritten as an analogous function $\boxed{Nf_S(E \geq E_{SNF}) \overset{def}{=} (E / E_0)^{\frac{7\ln(2)}{2\pi}} / N_{SNF}}$, with $\boxed{N_{SNF} \overset{def.}{=} k_{SNF}^{\frac{7\ln(2)}{2\pi}}}$ and $N_{SNF} \cong 1.41 \times 10^{14}$ being the SNF scaling factor "homologous" to N_a. Both exponential functions $Nf_a(E)$ and $Nf_S(E)$ have analogous structures (but inverse to each other): they can be represented on the same graph, as functions of a variable energy scale $E_{(GeV)}$, with $E_0 \leq E_{(GeV)} \leq E_{sup}$ and $E_{sup} \overset{def.}{\underset{estim.}{\cong}} 2.84 \times 10^{261}\,GeV$.
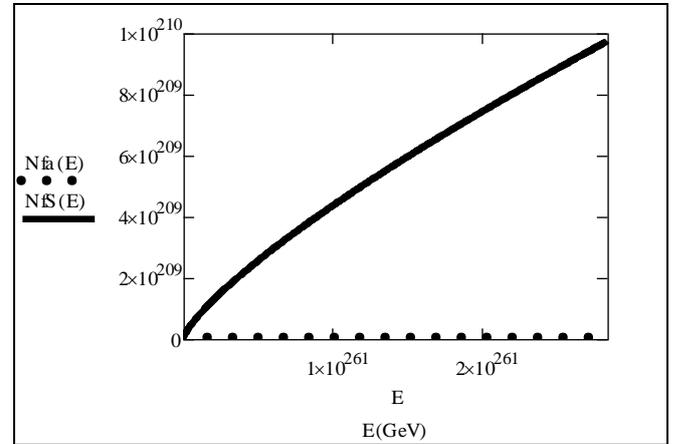

Figure IV-1. The comparative graph of $Nf_S(E)$ and $Nf_a(E_0)$ for $E_0 \leq E_{(GeV)} \leq E_{sup}$

b. The "circularity" between $Nf_S(E)$ and $Nf_a(E)$

There is a "circularity" between $Nf_S(E)$ and $Nf_a(E)$ which suggests a unity and complementarity between SNF and EMF running coupling constants. As E grows from $E_{inf} \overset{def.}{=} E_0$ to $E_{sup} \overset{def.}{=} E_0 \cdot N_a^{3\pi/\ln(4)} \cong 2.84 \times 10^{261}\,GeV$:

(1) the Nf_S function generates larger values up to $Nf_S(E_{sup}) \overset{estim.}{\cong} 2.65 \times 10^{202}$ corresponding to

$\alpha f_S \left(E_{sup} \right) \overset{estim.}{\cong} 1/672$ which has the same order of magnitude) to $\alpha = \alpha f \left(E_0 \right) \cong 1/137$ so that $\alpha F_S \left(E_{sup} \right) \cong 5\alpha$: at these very high energy scale, SNF may have a behavior and strength similar to EMF

(2) at the same time, Nf_a generates smaller values up to

$$Nf_a \left(\approx E_{sup} \right) \overset{estim.}{\cong} 1 \qquad \text{corresponding} \qquad \text{to}$$

$\alpha f \left(\approx x_{sup} \right) \overset{estim.}{\cong} 1$ which is relatively close (with the same order of magnitude) to

$\alpha f_S \left(E_p / E_{SNF} \right) \overset{estim.}{\cong} 0.6$, with $E_p = m_p c^2$.

Precisely, for $E_{a(p)} \overset{def.}{=}$

$\left[N_a / Nf_S \left(E_p / E_{SNF} \right) \right]^{3\pi/\ln(4)} \cdot E_{SNF} \overset{estim.}{\cong} 1.1 \times 10^{258} GeV$,

$\alpha f \left(E_{a(p)} \right) = \alpha f_S \left(E_p / E_{SNF} \right) \cong 0.6$: at these very high energy scale, EMF may have a behavior and strength similar to SNF

c. A plausible connection between the electrogravitational scaling factor N_a and the strong field scaling factor N_{SNF}

It may also exist a profound connection between the EGF scaling factor N_a and the SNF scaling factor N_{SNF}, as N_{SNF} may be hypothetically deducted from N_a, because $k_{SNF} \cong 2.1 \times 10^{18}$ has the same order of magnitude with the ratio $\boxed{N_a^{1/2} / a \cong 3.1 \times 10^{18}}$ such as $\dfrac{N_a^{1/2}}{3a/2} \overset{pred.}{\underset{98\%}{\cong}} k_{SNF}$,

$\left(\dfrac{N_a^{1/2}}{3a/2} \right)^{\frac{7\ln(2)}{2\pi}} \overset{pred.}{\underset{98.4\%}{\cong}} N_{SNF}$ and

$\dfrac{N_a^{1/2}}{3a/2} E_0 \overset{pred.}{\cong} 206 MeV \overset{pred.}{\underset{98\%}{\cong}} E_{SNF}$, which is in the

uncertainty interval of $E_{SNF} \overset{exp.}{\cong} 210 (\pm 40) MeV$. A possible new definition of $Nf_S \left(E \right)$ emerges as

$$\boxed{\boxed{Nf_S \left(E \geq E_{SNF} \right) \overset{def.2}{=} \dfrac{\left(E/E_0 \right)^{\frac{7\ln(2)}{2\pi}}}{N_a^{1/2}/\left(3a/2 \right)}}}$$

This TMU also proposes a simple and elegant function that connects the QCD energy scale (as approximated by the neutron and proton rest masses) with N_a:

$\boxed{\beta_n{}^2 \ln \left(\beta_n \right) \overset{pred.}{\underset{99.999\%}{\cong}} a^\pi \ln(a)}$ and $\boxed{\beta_p{}^2 \ln \left(\beta_p \right) \overset{pred.}{\underset{99.71\%}{\cong}} a^\pi \ln(a)}$,

as β_n and β_p are very close to the single real positive solution of the equation $\boxed{x^2 \ln(x) = a^\pi \ln(a)} \Leftrightarrow$

$\boxed{x\sqrt{\ln(x)} = a^{\pi/2}\sqrt{\ln(a)}}$ determinable using the Lambert W function. This simple logarithmic equation also explains the relative closeness of the value of $\beta_n \cong 1838$ and $\beta_n \cong 1836$ to $a^{3/2} \cong 1604$, a fact that also helped in the extraction of mbl-TH from Sirag's observation $\log_2 \left(a_{Gv} \right) \cong a$.

In conclusion, N_a is a potential unifying strong-electro-gravitational scaling factor.

V. THE WEAK NUCLEAR FIELD (WNF)

1. The relation between SNF and WNF running coupling constants

WNF is essentially a contact field/force with a finite and very short range/length of measurable action, as it is mediated by the W and Z bosons, which both have very large energies at rest $E_W \cong 80 GeV$ and $E_Z \cong 91 GeV$ (a feature explained by the Higgs mechanism, which is an essential part of SM) and very short mean lifetimes $t_W \cong t_Z \cong 3 \times 10^{-25} s$ (an instability explained by the relative largeness of E_W and E_Z)

The WNF strength is measured by the WNF running coupling constant α_W. The variation of α_W can be defined by a function $\alpha f_W \left(E \geq E_0 \right)$, which can also be calculated by using the same beta function $\beta(g) = \partial g / \partial \ln(g)$ mentioned for $\alpha f \left(E \geq E_0 \right)$ and $\alpha f_S \left(E > E_{SNF} \right)$.

$\alpha f_W \left(E \geq E_0 \right)$ is approximated as an exponential function that shows an inversely-proportional variation of α_W with the length scale λ and a directly-proportional variation of α_W with the energy scale $E \left[= E_{ph} \left(\lambda \right) = hc / \lambda \right]$ which appears as a denominator in a ratio that also includes the energy (at rest) of a W/Z boson defined formally as a geometric mean $E_{WZ} \overset{def.}{=} \sqrt{E_W \cdot E_Z}$, so that:

$$\boxed{\alpha f_W \left(\lambda \right) \overset{exp.}{\cong} \dfrac{0.02}{e^{E_{WZ}/(hc/\lambda)}} \overset{exp.}{\cong} \dfrac{1/50}{e^{2\pi E_{WZ}/E_{ph}(\lambda)}}} \qquad \textbf{(V-1a)}$$

$$\boxed{\alpha f_W \left(E \geq E_0 \right) \overset{exp.}{\cong} \dfrac{1/50}{e^{2\pi E_{WZ}/E}} \overset{exp.}{\cong} \dfrac{1}{50 \cdot \left(e^{2\pi} \right)^{E_{WZ}/E}}} \qquad \textbf{(V-1b)}$$

Analogously to $\alpha f \left(E \right)$ and $\alpha f_S \left(E \right)$, $\alpha f_W \left(E \right)$ can also be considered as derived from a function of form:

$$\boxed{Nf_W \left(E \geq E_0 \right) \overset{def}{=} 50 \cdot \left(e^{2\pi} \right)^{E_{WZ}/E}} \qquad \text{so} \qquad \text{that}$$

$\alpha f_W \left(E \geq E_0 \right) \overset{def}{\underset{exp.}{\cong}} 1 / Nf_W \left(E \right)$.

To also "align" $Nf_W \left(E \geq E_0 \right) \overset{def}{=} 50 \cdot \left(e^{2\pi} \right)^{E_{WZ}/E}$ to the other functions $Nf_a \left(E \geq E_0 \right) = N_a / \left(E / E_0 \right)^{\frac{\ln(4)}{3\pi}}$ and $Nf_S \left(E \geq E_{SNF} \right) \overset{def}{=} \left(E / E_0 \right)^{\frac{7\ln(2)}{2\pi}} / N_{SNF}$ by using the same base rest energy level of E_0, $Nf_W \left(E \right)$ can be also written as a function of E_0 such as

$$Nf_W \left(E \geq E_0 \right) \overset{def\,(1)}{=} 50 \cdot e^{2\pi k_{WZ} \cdot (E_0/E)},$$ with

$$k_{WZ} \overset{def.}{=} E_{WZ} / E_0 \cong 8.56 \times 10^{20}.$$

There may also exist a profound connection between the EGF scaling factor N_a and the WNF scaling factor k_{WZ}, as $k_{WZ} \cong 8.56 \times 10^{20}$ has the same order of magnitude with $\sqrt{N_a} \cong 4.23 \times 10^{20}$, so that $2\sqrt{N_a} \overset{pred.}{\underset{98.8\%}{\cong}} k_{WZ}$ and

$$Nf_W \left(E \right) \overset{def\,(2)}{\cong} 50 \cdot e^{\left(4\pi \sqrt{N_a} \right) \cdot (E_0/E)}$$

In conclusion, N_a is a potential unifying strong-electroweak-(electro)gravitational scaling factor.

VI. A UNIFIED SCALAR FOR ALL THE FOUR FUNDAMENTAL FORCES/FIELDS

This TMU proposes a unified scalar $F_N \left(x, N_a \right)$ for all the four fundamental fields, with $x = E / E_0$ and $E_0 \cong 10^{-10} eV$.

$$\boxed{F_N \left(x, N_a \right) =} \qquad \text{(VI-1)}$$

THE ELECTRO-GRAVITATIONAL FIELD

$$= \begin{cases} \boxed{Nf_a \left(x \right) = N_a / x^{\frac{\ln(4)}{3\pi}}}, for\, x \geq 1 \\ AND \\ \boxed{\alpha f \left(x \right) \overset{def.}{\cong} 1 / \log_2 \left[Nf_a \left(x \right) \right]}, for\, 1 \leq x < N_a^{3\pi/\ln(4)} \end{cases}$$

THE WEAK NUCLEAR FIELD

$$= \begin{cases} \boxed{Nf_W \left(x \right) \overset{def.1}{=} 50 \cdot e^{2\pi k_{WZ} \cdot (1/x)}} \overset{def.2}{\cong} \boxed{50 \cdot e^{\left(4\pi \sqrt{N_a} \right)(1/x)}} for\, x \geq 1 \\ AND \\ \boxed{\alpha f_W \left(x \right) \overset{def.}{\cong} 1 / Nf_W \left(x \right)}, for\, x \geq 1 \end{cases}$$

THE STRONG NUCLEAR FIELD

$$= \begin{cases} \boxed{Nf_S \left(x \right) \overset{def.1}{=} \dfrac{x^{\frac{7\ln(2)}{2\pi}}}{N_{SNF}}} \overset{def.2}{\cong} \boxed{\dfrac{x^{\frac{7\ln(2)}{2\pi}}}{N_a^{1/2} / (3a/2)}} for\, x \geq N_{SNF} \\ AND \\ \alpha f_S \left(x \right) \overset{def.}{=} 1 / \log_2 \left[Nf_S \left(x \right) \right], for\, x > N_{SNF} \end{cases}$$

VII. A CYCLIC CLOSED UNIVERSE HYPOTHESIS (CCUH)

1. A cyclic closed universe hypothesis (CCUH) based on DRH and the electrogravitational scaling factor N_a

As it can be remarked from the paper chapter dedicated to the Quantum electrogravitational field, both N_a-based predictions $\boxed{\left(N_a^2 / \sqrt{a} \right) \cdot m_H \overset{pred}{\cong} 1.48 M_U}$ and $\boxed{N_a^2 \cdot m_H \overset{pred.}{\cong} 17.3 M_U}$ suggest a global mass of OU larger than the most recent estimations of $M_U = E_U / c^2 \cong 3.1 \times 10^{54} kg$. CCUH states that it is very plausible for the total mass of OU $\left(M_{tU} \right)$ to be just slightly larger than M_U, so that $M_{tU} = \left(N_a^2 / a^{1/2} \right) \cdot m_H \overset{pred.}{\cong} 1.48 M_U$ and $E_{tU} = M_{tU} c^2 \overset{pred.}{\cong} 1.48 E_U$. If the predicted energy excess $\Delta E \overset{pred.}{=} E_{tU} - E_U \overset{pred.}{\cong} 0.48 E_U$ is located in the interior of $V_U = \left(4\pi / 3 \right) R_U^3$ (in a state possibly inaccessible to our experimental measurements), then it results an energy density of $\rho_{tU} = 0.48 \rho_U \cong 0.48 \rho_{Ec} \cong 1.14 \times 10^{-9} J / m^3$ which is larger than the critical energy density defined in standard Friedmann universe model as $\rho_{Ec} = 3 H_0^2 / \left(8\pi G / c^2 \right) \cong 7.72 \times 10^{-10} J / m^3$, predicting a close universe with at least one inflation-deflation cycle (a finite classical time interval t_c between the Big Bang moment and a plausible Big Crunch moment), with $\Omega_f \left(\rho_{tU} \right) \cong 1.48$, a universe that may finally show a decelerated inflation up to a maximum radius $R_{U(\max)}$ and then deflate and collapse in a so-called Big-Crunch (possibly followed by another inflation-deflation cycle): this scenario would also imply a finite global angular momentum of OU, with a fixed value $L_{tU} = E_{tU} \cdot t_c$. As also observed, this TMU goes beyond SM and the standard present cosmology data and predicts that the rest mass/energy of the white universe (**WU**) (defined as all the observable ordinary matter and radiation) $M_{WU} \cong 10^{53} kg$ may represent only $M_{WU} / M_{tU} \cong 2.2\%$

of the total $M_{tU}\left(=1.48M_U \cong 4.56\times10^{54}kg\right)$, which implies that the dark universe (**DU**) (defined as the sum between dark energy and dark matter) to represent more than 97% of OU. CCUH essentially proposes a Phoenix-type universe **[54,55]**: Barrow's Singular inflation theory **[56]** and Turok's Cyclic Model of the Universe (M-Theory Model of a Big Crunch/Big Bang Transition) **[57,58]** also sustain this possibility.

Based on DRH, CCUH also includes additional statements (sub-hypotheses):

(**1**) *it is very plausible that this universe cycle is not the first and neither the least possible cycle of OU (which implies at least 3 different consecutive cycles and a potential infinite number of such cycles);*

(**2**) *it is very plausible that both $L_{tU} = E_{tU}\cdot t_c$ and N_a to have fixed values throughout all this present cycle of OU (1st rank parameters),* but the same $L_{tU} = E_{tU}\cdot t_c$ may split in a different $\left[E_{tU(x)}, t_{c(x)}\right]$ combination, from one cycle to another, so that $E_{tU(x)}\cdot t_{c(x)} \underset{const.}{\overset{pred.}{=}} L_{tU}$: the fixed value of N_a per one cycle also implies a fixed value for

$$\underset{(fixed)}{a} \overset{def.}{=} \log_2\left(\underset{(fixed)}{N_a}\right) \quad \text{and} \quad \underset{(fixed)}{\alpha} \overset{def.}{=} 1/\underset{(fixed)}{a},$$

$$\underset{(fixed)}{a_{Gq}} \overset{def.}{=} 2\cdot \underset{(fixed)}{a}^{3/2}\cdot N_a \quad \text{and} \quad \underset{(fixed)}{\alpha_{Gq}} \overset{def.}{=} 1/\underset{(fixed)}{a_{Gq}},$$

$$\underset{(fixed)}{K_{eg}} \overset{def.}{=} 2\underset{(fixed)}{\alpha}^{-1/2} \underset{(fixed)}{N_a} \quad (1^{st}\text{ rank co-parameters) (as}$$

stated by mbl-TH); $\quad k_{WZ} \underset{98.8\%}{\cong} 2\underset{(fixed)}{N_a}^{1/2} = fixed \quad$ and

$$k_{SNF} \underset{98\%}{\cong} \underset{(fixed)}{N_a}^{1/2}/\left(3a/2\right) = fixed \quad (1^{st}\text{ rank co-parameters)};$$

additionally, CCUH also considers very plausible that $Nf_a(x)$, $Nf_W(x)$ and $Nf_S(x)$ (together with their associated running coupling constants functions $\alpha f(x)$, $\alpha f_W(x)$ and $\alpha f_S(x)$ respectively) are also fixed scalars throughout all this present cycle of OU (1st rank co-functions/rules). The constancy of L_{tU} may motivate the formulation of an Universal Equivalence Principle (**UEP**) **UEP[L]** (t stands for generic time, E stands for generic energy, F stands for generic force and M stands for generic mass), such as:

$$\left[L\left(=E\cdot t\right)\equiv 1 \Leftrightarrow E \equiv 1/t\right] \Rightarrow \left[F = E/d\right]\equiv 1/\left(d\cdot t\right)$$

$$\text{and } \left[M = F/\left(d/t^2\right)\right]\equiv\left[E\cdot t^2/d^2\right]\equiv\left[t/d^2\right]$$

(**3**) *it is very plausible for c, h and q_e to also have fixed values throughout all this present cycle of OU (1st rank co-parameters),* which implies a "fixed" photon with a fixed angular momentum quanta that permits only frequency/wavelength variations and implicitly energy quanta variation by definition

$$\underset{(var.)}{E_{ph}}\left(\underset{(var.)}{\lambda}\right) \overset{def.}{=} \underset{(fixed)}{h}\cdot\underset{(fixed)}{c}/\underset{var.}{\lambda} = \underset{fixed}{h}\cdot\underset{(var.)}{\nu}: \text{ as } \alpha \text{ also}$$

has a fixed value (by its mbl-TH-based definition), it results that $\underset{(fixed)}{k_C \overset{def.}{=} \left(c/q_e^2\right)/\left(2\pi a\right)} = fixed \Rightarrow \underset{(fixed)}{k_e \overset{def.}{=} f\left(h\right) = k_C\cdot h} = fixed$

(1st rank co-parameters); as α_{Gq} also has a fixed value (by mbl-TH-based definition), it results that

$$G_q m_e^2 \overset{def.}{=} \underset{(fixed)}{\alpha_{Gq}}\cdot\underset{(fixed)}{\left(\hbar c\right)} = fixed \quad (1^{st}\text{ rank co-parameter)}.$$

The constancy of h also supports **UEP[L].** The constancy of c may motivate the formulation of **UEP[c]** as:

$$\left[d/t \equiv 1 \Leftrightarrow d \equiv t\right]\overset{UEP[L]}{\Rightarrow}\left[F = E/d\right]\equiv 1/t^2 \equiv 1/\left(d\cdot t\right)\equiv 1/d^2$$

$$\text{and }\left[M = F/\left(d/t^2\right)\right]\equiv\left[E\cdot t/d\right]\equiv\left[1/d\right]\equiv\left[1/t\right]$$

(**4**) *it is very plausible for m_e to also have a fixed value throughout all this present cycle of OU (1st rank co-parameter related to the other 1st rank co-parameters listed next),* which implies a "fixed" electron with an energy (at rest) having a fixed value $\underset{(fixed)}{E_e} \overset{def.}{=} \underset{(fixed)}{m_e}\cdot c^2 = fixed$, a specific charge of the electron $\underset{(fixed)}{q_e}/\underset{(fixed)}{m_e}$ with a fixed value, a classical electron radius with a fixed value, such as:

$$\underset{(fixed)}{r_e} \overset{def.}{=} k_e q_e^2/\underset{(fixed)}{E_e} = fixed, \text{ a fixed quantum G scalar}$$

$$G_q = \left(\underset{(fixed)}{\alpha_{Gq}}\cdot\underset{(fixed)}{\left(\hbar c\right)} \overset{def}{=} \underset{(fixed)}{G_q m_e^2}\right)/\underset{(fixed)}{m_e^2} = fixed,$$

$$\underset{(fixed)}{k_G \overset{def.}{=} \left(c/m_e^2\right)/\left(2\pi a\right)} = fixed \Rightarrow \underset{(fixed)}{h_{eg}} \overset{def.}{=} \underset{(fixed)}{G_q}/\underset{(fixed)}{k_G} = fixed,$$

with h_{eg} also being the "base" of the series

$$hs_{eg}\left(E_{BN}\right)\overset{def.}{\underset{pred.}{=}} h_{eg}\cdot\left(1+\frac{E_{BN}}{\beta_N m_e c^2}\right) \text{ and } Gs_q\left(E_{BN}\right)\overset{def.}{\underset{pred.}{=}} k_G\cdot hs_{eg}\left(E_{BN}\right)$$

(with a formal definition $\beta_N \overset{def.}{=} \sqrt{\beta_p\cdot\beta_n}$, which is also very close to the exact solution x in the equation $x^2\ln\left(x\right) = \underset{(fixed)}{a^\pi}\ln\left(a\right)$. The constancies of G_q and $G_q m_e^2$ are equivalent with the constancy of $k_e q_e^2$ and may motivate the formulation of **UEP[G]** as:

$$\left[d^3/\left(M\cdot t^2\right)\equiv 1\right]\overset{UEP[L]}{\underset{UEP[c]}{\Rightarrow}}\left[M \equiv d^2 \equiv t^2\right]\overset{UEP[L]}{\underset{UEP[c]}{\Rightarrow}}$$

$$\left[\left(d^3 \equiv 1\right)and\left(t^3\equiv 1\right)\right]\overset{UEP[L]}{\underset{UEP[c]}{\Rightarrow}} \quad \left[F = M\cdot d/t^2\right]\equiv d \equiv t \overset{UEP[L]}{\underset{UEP[c]}{\Rightarrow}}$$

$$\left[E = F\cdot d\right]\equiv d^2 \equiv t^2\left[\equiv M\right] \Rightarrow \quad \boxed{E \equiv M}. \quad \text{In}$$

conclusion $E \equiv M \equiv d^2 \equiv t^2$ is a unified formulation for both the Einstein's Energy-Mass Equivalence Principle and the 't Hooft's holographic principle (subsequently developed by Leonard Susskind) (which states that mass and energy are essentially holographic, as they are storable on the 2D spherical surface of a black-hole).

$$\left[E = 1/t = 1/d\right] \equiv \left[M = 1/t = 1/d\right] \equiv \left[d^2 \equiv t^2\right] \overset{UEP[L]}{\underset{UEP[c]}{\Rightarrow}}$$

$$\boxed{\boxed{L \equiv 1 \equiv d^3 \equiv t^3}}$$ implies that, even if E and M are storable on a 2D surface of a black-hole, angular momentum needs a 3D (volumic) space to be stored as a phase space: in this way, the conjugated UEP[L], UEP[c] and UEP[G] (in this given order of priority) support the necessity of a space with a minimum 3 (relative) dimensions to store angular momentum, and that may further support

the validity of $\boxed{L_{tU} \underset{def.}{\overset{pred.}{=}} h \cdot N_a^{\ 3} = E_{tU} \cdot t_c}$ definition.

(**5**) As h and N_a both have fixed values throughout all this present cycle of the universe and h defines the angular momentum of a periodic phenomenon (the photon, which is both a wave and a particle ["wavicle"] defined by a frequency $\nu = 1/\Delta t$, which measures a full oscillation cycle of EMF) with $h \cong L_U / N_a^{\ d \cong 2.96}$, then product

$\boxed{h \cdot N_a^{\ 3} \cong 3.78 \times 10^{90} Js}$ is a very plausible candidate for the angular momentum of a global oscillation of our perceptual 3D space also measured by $\boxed{L_{tU} = E_{tU} \cdot t_c}$;

based on the plausible equality

$\boxed{\boxed{L_{tU} \underset{def.}{\overset{def.}{=}} E_{tU} \cdot t_c \overset{pred.}{=} h \cdot N_a^{\ 3}}}$, *CCUH proposes an*

estimation of the present universal cycle (finite) duration t_c

as $\boxed{t_c \overset{def.}{=} L_{tU} / E_{tU} = h \cdot N_a^{\ 3} / E_{tU}} \Rightarrow \quad t_c \overset{estim.}{\cong} (21) t_U$

$\cong 292 \times 10^9$ *years which may indicate that we witness the* "*infancy*" *of OU defined by the ratio* $t_U / t_c \cong 4.7\%$

Based on this new estimation of $L_{tU} \overset{def.}{=} h \cdot N_a^{\ 3} \cong 3.78 \times 10^{90} Js$, CCUH proposes the

redefinition of the function $\boxed{hf_{eg}(d) \overset{def.1}{=} L_U / N_a^{\ d}}$ as

$\boxed{hf_{eg}(d) \overset{def.2}{=} L_{tU} / N_a^{\ d}}$, so that $\boxed{hf_{eg}(3) \underset{pred.}{\overset{estim.}{=}} L_{tU} / N_a^{\ 3} = h}$

and $\boxed{hf_{eg}(4) \underset{pred.}{\overset{estim.}{=}} L_{tU} / N_a^{\ 4} \cong (23.4) h_{eg} \cong 3.71 \times 10^{-75} Js}$.

CCUH also proposes the redefinition of the function

$\boxed{d(h_x) \overset{def.1}{=} \log_2(L_U / h_x)/a \overset{def.1}{=} \log_{N_a}(L_U / h_x)}$ as,

$\boxed{d(h_x) \overset{def.2}{=} \log_2(L_{tU} / h_x)/a \overset{def.2}{=} \log_{N_a}(L_{tU} / h_x)}$, so that

$\boxed{d_h \underset{pred.2}{\overset{estim.2}{=}} d(h) = 3}$, $\boxed{d_{Hig} \underset{pred.2}{\overset{estim.2}{=}} 2.96 \cong 3}$ and

$\boxed{d_{eg} \underset{pred.2}{\overset{estim.2}{=}} d(h_{eg}) \cong 4.033}$. The fact that

$\boxed{d_{eg} \cong 4.033 > 4}$ (slightly larger than 4) suggests that there may exist at least one additional relative 5th dimension

defined by $\boxed{h_{str} \underset{pred.2}{\overset{def.2}{=}} hf_{eg}(5) \overset{estim.2}{=} L_{tU} / N_a^{\ 5}}$,

$h_{str} \overset{estim.2}{\cong} 2.1 \times 10^{-116} Js \ll h_{eg}$ which may be considered the angular momentum quanta of an elementary string

associated with the 5D frame. $\boxed{L_{tU} \underset{def.}{\overset{pred.}{=}} \frac{h}{fixed} \cdot \frac{N_a^{\ 3}}{fixed} = fixed}$

$\Rightarrow \boxed{d_h \underset{pred.2}{\overset{estim.2}{=}} d(h) = \log_2(L_{tU} / h)/a = 3 = fixed}$: it is very plausible that OU started as a 3D space from the first moment after Big-Bang and will end as a 3D space (no matter if a finite t_c indicates an inflation-deflation cycle or just an accelerated - decelerated inflation followed by an "eternal rest" in an expanded final form, a fact that implies the ceasing of the classical linear time, which cannot be measured in the absence of any movement): this 3D space constancy defined by L_{tU}, N_a, h and d_h (all these four parameters having fixed values) is also the most probable explanation for the homogeneity and isotropy of this 3D space of OU, but also for the relative homogeneity of the energy-matter distribution in this 3D space of OU which may be the consequence of the relative homogeneity of the angular momentum distribution in the same 3D space of OU.

In its inflation/expansion, OU may be viewed as composed of two halves (approximately) equal that attract reciprocally opposing the inflation: this attraction can be quantized by a gravitational angular momentum (**GAM**)

with a scalar defined as $hf_G(M_{tU}) \overset{def.}{=} G(M_{tU} / 2)^2 / c$.

$hf_G(M_{tU}) \cong 1.16 \times 10^{90} Js$ has the same order of

magnitude with $L_{tU} \overset{def.}{=} h \cdot N_a^{\ 3} \cong 3.78 \times 10^{90} Js$, but is lower than L_{tU}: this fact suggests that L_{tU} has both an attraction (anti-inflationary) component

$\boxed{L_{tU(a)} \overset{def.}{=} hf_G(M_{tU}) \cong 0.3 L_{tU}}$ and a repulsion (pro-inflationary) component that can be defined (by difference)

as $\boxed{L_{tU(r)} \overset{def.}{=} L_{tU} - L_{tU(a)} = L_{tU} - hf_G(M_{tU}) \cong 0.7 L_{tU}}$,

with $L_{tU(r)} \cong (2.3) L_{tU(a)}$.

If hypothesized that $L_{tU(r)}$ is the consequence of a form of repulsive gravity that manifested at the Big Bang moment, with a scalar similar to the Newtonian attractive gravity (directly-proportional with the mass product and inversely-proportional to the square of distance between those masses, but without necessarily implying that the diameter of the two masses to be much smaller than the distance between those masses) so that

$L_{tU(r)} = G_x \left(M_{tU} / 2 \right)^2 / c$, the gravitational constant of this repulsive gravity can be estimated as $G_x = L_{tU(r)} \cdot c / \left(M_{tU} / 2 \right)^2 \cong 2.26 G$. The fact that

$$\boxed{L_{tU} \underset{def.}{\overset{pred.}{=}} h \cdot N_a{}^3 = L_{tU(a)} + L_{tU(r)}}$$ brings an additional

argument for the validity of N_a as a very plausible unifying electrogravitational scaling factor and also a propriety of the spacetime itself as it correlates the 3D-frame (with its associated photon and 3D-eg) with the 4D-frame (with its associated 4D-eg)

(**6**) *It is very plausible that* $E_{sup} \overset{def.}{=} E_0 \cdot N_a{}^{3\pi / \ln(4)}$
$\cong 2.84 \times 10^{261} GeV$ *(which corresponds to* $Nf_a \left(E_{sup} \right) = 1$,
$\alpha f \left(E_{sup} \right) \overset{def}{\approx} 1 / 0 [Landau\ pole]$ *and which is over 180*

orders of magnitude larger than $E_{tU} \overset{estim.}{\cong} 2.56 \times 10^{81} GeV$ *)*
*to be a valid candidate for the upper bound of the total energy (at rest) of the (whole) real universe (**RU**), which may be finite, so that*

$$\boxed{E_{tU} \ll E_{RU} \underset{pred.}{\overset{def.}{<}} \left(E_{sup} \cong 2.84 \times 10^{261} GeV \right)}$$ and

$$\boxed{E_{RU} \gg E_{tU} \overset{estim.}{>} 10^{-180} E_{RU}}.$$

There are some strong arguments in the favor of a very-large-but-finite total global energy (at rest) E_{RU} and total global angular momentum L_{RU} (at rest) of the RU. *The Bekenstein bound (**BB**) conjectures that a finite quantity of space cannot compress other but a finite amount of information* (and implicitly a finite amount of angular momentum and energy): there are strong arguments for this conjecture to be true, in order to have General Relativity (GR) consistent to the laws of thermodynamics (Bekenstein argues that if a physical system (**PS**) would have an intrinsic entropy/information larger than BB, it may become possible for that PS to violate the second law of thermodynamics by spontaneously lowering its intrinsic entropy/information and turn into a black hole). *Quantum mechanics (**QM**) also predicts that QPs cannot occupy a space smaller than their wavelengths.* The loop Quantum Gravity Theory (**QGT**) also suggests that singularities (infinite amount of energy/mass in a finite amount of space) may not exist as there is probably a minimum distance beyond which the force of gravity no longer continues to increase as the distance between the masses becomes shorter (an asymptotic freedom [**AF**] of gravity similar to the SNF-AF). Another argument may be the circularity between EMF and SNF which may manifest inside a pre-Big-Bang singularity in which the very-large-but-finite L_{RU} (and also very-large-but-finite E_{RU} *and RU rest mass* M_{RU} *implicitly*) may be compressed in a volume comparable to that of a human head: $Nf_S \left(E_{sup} \right) \overset{estim.}{\cong} 2.65 \times 10^{202}$ corresponds to $\alpha f_S \left(E_{sup} \right) \overset{estim.}{\cong} 1 / 672$ which has the same order of magnitude) to $\alpha = \alpha f \left(E_0 \right) \cong 1 / 137$; at the same time,

$Nf_a \left(\approx E_{sup} \right) \overset{estim.}{\cong} 1$ corresponding to $\alpha f \left(\approx x_{sup} \right) \overset{estim.}{\cong} 1$ which is relatively close (with the same order of magnitude) to $\alpha f_S \left(E_p / E_{SNF} \right) \overset{estim.}{\cong} 0.6$): it is very seducing that in a pre-Big-Bang singularity SNF may play the role of and EMF-like force (with quarks, anti-quarks and gluons moving freely in this singularity) and vice versa (with EMF playing the role of a SNF-like force, with photons acting like gluons and "locking" the huge E_{sup} in a compressed volume comparable to that of a human head volume: a "coconut" universe), as if the present RU is an "upside-down" singularity and vice versa: the universe "in a nut shell" (in which gluons, quarks and anti-quarks move freely in that singularity, similarly to the nucleons that also move freely in the large volume of OU). The "duet" SNF-EMF may act like a universal "spring" that turns the RU-singularity into an expanded RU and vice versa, in an infinite succession of universal cycles measurable by a classical time interval t_c (not necessarily the same in every such a cycle).

Given all these previous arguments, *it is very plausible that a pre-Big Bang singularity cannot compress an infinite angular momentum / energy / mass in a finite volume: that is why this TMU considers as very plausible for* L_{RU}, E_{RU} *and* M_{RU} *to be all finite quantities generated from a pre-Big Bang singularity.*

Based on the hypothesis that RU may be sufficiently homogenous so that to have an average energy density $\overset{pred.}{\rho_{RU}} \cong \overset{pred.}{\rho_{tU}} \cong \left(1.48 \right) \rho_{Ec}$, CCUH also estimates an upper bound for the maximum RU volume V_{RU} that may compress all $E_{RU} \underset{pred.}{\overset{def.}{<}} E_{sup}$ so that $E_{tU} \ll \rho_{RU} V_{RU} \underset{pred.}{\overset{def.}{<}} E_{sup} \Rightarrow$

$V_U \ll V_{RU} \underset{pred.}{\overset{def.}{<}} E_{sup} / \rho_{RU} \Leftrightarrow V_U \ll V_{RU} \underset{pred.}{\overset{def.}{<}} 10^{180} V_U$ and an upper bound for the maximum radius of RU as $R_U \ll R_{RU} \underset{pred.}{\overset{def.}{<}} \left(V_{RU} / \left(4\pi / 3 \right) \right)^{1/3} \Leftrightarrow R_U \ll R_{RU} \underset{pred.}{\overset{def.}{<}} 10^{60} R_U$.
Wilkinson Microwave Anisotropy Probe (WMAP) has estimated from 2013 that the universe is flat with margin of error $e_{flat.} \overset{estim.}{\cong} 0.4\%$ which also concludes that $R_{RU} \gg R_U$: CCUH also brings a novel prediction to these experimental conclusions, such as this upper bound for $R_{RU} \gg R_U$, so that $R_U \ll R_{RU} \boxed{\underset{pred.}{\overset{def.}{<}} 10^{60} R_U}$.

E_{tU} may be compressed to a maximum energy density $\rho_{U(\max)}$ defined by one photonic energy quanta $E_{ph} \left(l_{Pl} \right) \cong 10^{20} E_p$ $\left(l_{Pl} \overset{def.}{=} \sqrt{hG / c^3} = Planck\ length \right)$ per each Planck volume $V_{Pl} \overset{def.}{=} \left(4\pi / 3 \right) l_{Pl}{}^3$, so that

$$\boxed{\overset{def.}{\rho_{U(\max)}} = E_{ph} \left(l_{Pl} \right) / V_{Pl}}, \quad \boxed{\rho_{U(\max)} \overset{estim.}{\cong} \left(10^{123} \overset{estim.}{\rho_{tU}} \right) \cong 10^{114} J / m^3}.$$

Based on $\rho_{U(\max)}$, CCUH may also estimate the minimum

volume $V_{U(min)}$ to which E_{tU} can be maximally compressed so that $V_{U(min)} = E_{tU} / \rho_{U(max)} \overset{estim.}{\cong} 213 V_p$, with $V_p \overset{def.}{=} (4\pi/3) r_p^3$ being the approximate spherical volume of a nucleon (proton/neutron) at rest and $V_{U(min)}$ approximating the size of a Radon nucleus (defined by Z=86 and A=222), which has a diameter of about 12 proton diameters (Radon is a highly radioactive rare chemical element/gas)

(7) CCUH also proposes a lower bound for the total angular momentum of RU based on the hypothesis that N_a may be an electrogravitational scaling factor not only for OU, but also for RU; CCUH also considers (in concordance with SST and MT) that $d_{estim.} = 5$ is a minimum number of (relative) dimensions of RU, with the electrograviton measured by h_{eg} corresponding to a 5D-frame, which implies that photons (with a quantum momentum measured by h) correspond to a 4D-frame, so that the lower bound of the total angular momentum of RU may be estimated as

$$\boxed{L_{eRU} \overset{pred.}{\underset{def.}{=}} h \cdot N_a^{d_{estim.}-1} = h \cdot N_a^4 = N_a \cdot L_{tU} = fixed} \Rightarrow$$

$$\boxed{d(h_x) \overset{def.3}{=} \log_2\left(L_{eRU}/h\right)/a}, \text{ with } \boxed{d_h \overset{estim.3}{\underset{pred.}{=}} d(h) \overset{def.3}{=} 4 = fixed}$$

and $\boxed{d_{eg} \overset{estim.3}{\underset{pred.}{=}} d\left(h_{eg}\right) \overset{def.3}{\cong} 5.03 = fixed}$. *CCUH also considers that both OU and RU (as RU also includes OU) emerged from the same singularity in a moment dated about* $t_U \cong 13.8 \times 10^9$ *years, so that both RU and OU share the same age, and may also share the same cycle duration measured by* t_c, *so that* $\boxed{t_{RU} \underset{hypoth.}{\overset{def.}{=}} t_{tU} \underset{hypoth.}{\overset{def.}{=}} t_c}$. The estimated total energy of RU (at rest) E_{eRU} may be deducted from $L_{eRU} \overset{estim.}{\cong} 10^{41} L_{tU}$ as $\boxed{E_{eRU} \overset{pred.}{\underset{def.}{=}} L_{eRU}/t_c} \overset{estim.}{\cong} 10^{41} E_{tU} \overset{estim.}{\cong} 10^{122} GeV$. The estimated total mass of RU (at rest) M_{eRU} may be deducted from E_{eRU} as $\boxed{M_{eRU} \overset{pred.}{\underset{def.}{=}} E_{eRU}/c^2} \overset{estim.}{\cong} 10^{41} M_{tU}$

$\overset{estim.}{\cong} 10^{96} kg$. It is important to note that the energy function $\boxed{Ef_{eRU}(d) \overset{pred.}{\underset{def.}{=}} h \cdot N_a^d / t_c}$ has value that fit the condition

$E_{tU} \ll Ef_{eRU}(d) \underset{pred.}{\overset{def.}{<}} E_{sup}$, for all the integers d=4, 5, 6 and 7, such as $E_{sup} / Ef_{eRU}(4) \overset{estim.}{\cong} 10^{139}$ and $E_{sup} / Ef_{eRU}(7) \overset{estim.}{\cong} 10^{15}$.

Based on $\rho_{U(max)}$, CCUH may also estimate the minimum volume $V_{eRU(min)}$ to which E_{eRU} can be maximally compressed so that $\boxed{V_{eRU(min)} = E_{eRU} / \rho_{U(max)}}$

$\overset{estim.}{\cong} 10^{43} V_p$: $V_{eRU(min)}$ corresponds to the size of a sphere with a radius of $r_{eRU} = \left[V_{eRU(min)}/(4\pi/3)\right]^{1/3} \cong 29 cm$

(**8**) *The fact that life on Earth was demonstrated to be at least* $t_l \cong 4 \times 10^9$ *years old, indicates that the first life forms (LFs) may had been appeared after the passing of just about* $(t_U - t_l)/t_c \cong 3.4\%$ *of the whole universal cycle measured by* t_c *(starting from the Big-Bang moment): CCUH considers very plausible that this fact may not be not just a simple coincidence*, as there is a strong contrast between this small percent and the astonishing complexity of life forms (**LFs**) and life societies (the complexity of the Earth biosphere as a whole, with a lifespan of about $t_l / t_U \cong 30\%$, which is a significant part of the t_U interval, which implies a significant overlap between t_c t_U). Based on this double-argument, *CCUH also considers very plausible that life may be essentially a predesigned phenomenon probably "engraved" in the laws of nature (including the still unknown laws of OU), and just secondarily shaped by different so-called "natural accidents". There are also some strong arguments that creationism and evolutionism can be unified in a more profound monad.* It is generally considered that the non-0 probability of life existence strongly depends on: boson-fermion dichotomy (**BFD**) (associated with Pauli's exclusion principle [**PEP**] which apply to all fermions), some narrow intervals of allowed variations (±4%) for α values (at rest) and for the beta constants values at rest (β_p and β_n) (which influence the formation and the life cycles of the stars, which are the main sources of energy for LFs and the only source of atoms heavier that the iron, which are vital microelements for the LFs); it is also generally admitted (and partially proved by some experiments) that α, β_p β_n values (at rest) have probably been "decided" (by so-called natural (pre)selection) in the first moments after the (hypothetical but very probable) Big-Bang. It was also demonstrated that the stability of all chemical structures that compose any LF mainly depend on BFD-PEP association, α, β_p and β_n values (at rest). In order for the first LFs to appear by the 3rd step of "biological natural selection", proper chemical structures (atoms and molecules) must have been produced long before these first LFs by a 2nd step of "chemical natural (pre)selection": but this 2nd step of "chemical natural (pre)selection" strongly depends on α, β_p and β_n values (at rest) that were also "naturally (pre)selected" at a relative short moment after the Big-Bang and this "selection" may be consider the 1st step of the "natural selection" process, that can be named the "alpha-beta natural (pre)selection". In this way, this CCUH proposes a "natural selection" in three "ABC" steps:

(**A**) the selection of the main physical principles and adimensional constants compatible with life (very close to the Big-Bang moment);

(**B**) the selection of the atoms and molecules compatible with life;

(**C**) the appearance of the first LFs that evolved by a so-called "natural selection" process

With this arguments, CCUH proposes the unification of evolutionism and creationism in a monad (a seed-like model of the pre Big-Bang singularity in which this singularity unpacks and re-packs itself periodically, generating a RU populated with life), as it pushes the three-steps "natural selection" very close to the moment "0" of the Big Bang when α, β_p β_n *values (at rest). were probably "naturally" (but not necessarily randomly!) selected.*

An important remark on the importance of FSC value in the structures and functions of LFs. A change in the energy level of an electron in a molecule of a LF may produce a change in configuration of that molecule, a change that may also generate and transmit potential vital information for that LF. FSC can be interpreted as the probability of a real electron to emit a real photon (Feynman's interpretation): in biology, FSC can be "translated" as the main probabilistic measure of the relative stability of a molecular electronic cloud configuration that a LF can rely on as a generator and transmitter of information.

Check-point conclusion. All the statements (including the retrodictions) of CCUH generally match the experimental observation of OU. The predictions of CCUH are different from those proposed by DLNH and may offer some (potential valid) updates for the Standard Model of particle physics, updates that may have a far reaching impact on SM, in a medium and long term.

VIII. LIFE AS A FUNDAMENTAL FIELD HYPOTHESIS (LFFH)

A fundamental physical field (**FPF**) may be represented as a graph composed by nodes (a specific set of QPs) and internodes which are (all-to-each and each-to-all) bidirectional flows of physical information (**PI**) between all the nodes.

In a 3D frame of reference, PI may be measured by the angular momentum transferred between the nodes of a FPF graph, so that: $\boxed{PI_{3D} = L}$, *generic energy* $\boxed{E = L / t = PI_{3D} / t}$ *can be interpreted as the speed of* PI_{3D} *transfer; generic force* $\boxed{F = E / d = \left(PI_{3D} / d \right) / t}$ *can be interpreted as the speed of PI_{3D} transfer per unit of length (including the circumference of emission/reception of a QP or a QP-based object); generic mass* $\boxed{M = F / \left(d / t^2 \right)}$ $\boxed{= \left(PI_{3D} \cdot t \right) / d^2}$ *can be interpreted as the PI transfer in a frame of time* $t \equiv \Delta t$ *per unit of area).*

The limits of interpretation of the product $PI_{3D} \cdot t$ suggests that it is more convenient to measure PI in the *4D frame of the electrograviton, so that:* $\boxed{PI_{4D} = PI_{3D} \cdot t = L \cdot t}$; *the generic angular momentum* $\boxed{L = PI_{4D} / t}$ *can be interpreted as the speed of PI_{4D}*

transfer; generic energy $\boxed{E = L / t = \left(PI_{4D} / t \right) / t}$ can be interpreted the acceleration of PI_{4D} transfer; generic force $\boxed{F = E / d = \left(PI_{4D} / d \right) / t^2}$ can be interpreted as the acceleration of PI_{4D} transfer per unit of length (including the circumference of emission/reception of a QP or a QP-based object); generic mass $\boxed{M = F / \left(d / t^2 \right)}$ $\boxed{= PI_{4D} / d^2}$ can be interpreted as the PI_{4D} distribution per unit of per unit of area or a PI_{4D} "pressure"). At the same time, PI_{4D} is also a PI quantity that can be theoretically measured in bits, like any standard information quantity (or in qubits [qbits], in the case of a quantum physical system). Based on this simple hypothesis, all the main SI units may be derived from the bit of the 4D frame electrograviton, so that: $\boxed{J \cdot s = bit / s}$, $\boxed{J = bit / s^2}$, $\boxed{N = \left(bit / m \right) / s^2}$ and $\boxed{kg = bit / m^2}$.

Each FPF has its own specific layer of internodes and its set of nodes (which may partially or totally overlap the node sets of the other FPFs) : (**1**) the EGF layer (connecting all QPs in SM, at any distance; mediated by the hypothetical electrogravitons (egs) as EGF quanta, one eg for each frame with a positive integer number of relative dimensions); (**2**) the EMF layer (connecting all electro-charged QPs in SM, at any distance; mediated by the photons as EMF quanta) (**3**) the WNF layer (connecting all QPs in SM, but with measurable strength only at very short distances; mediated by the W and Z bosons as WNF quanta); (**4**) the SNF layer (connecting just the quarks, but with measurable strength only at short distances; mediated by the gluons)

LFs also keep their integrity by using (all-to-each and each-to-all) bidirectional flows of biological information (**BI**) between all their modules which are organized in multiple layers: based on this simple observation, this TMU proposes a new generalized/extended definition of the fundamental physical field as a fundamental biophysical field (**FBF**) based on the extended concept of biophysical information (**BPI**), *which may be defined as any information that is used or may be potentially used by a LF to make decisions (including survival and reproduction). FBF may be defined as any (all-to-each and each-to-all) bidirectional flow of BPI between a specific set of modules of RU and/or LF modules of the same biological type.*

Life as a fundamental field hypothesis (LFFH): Based on this simple definitions, this TMU considers life as a superposition of one to seven single-layered FBFs (plus the four FPFs), each FBF being defined by a BPI flow between a specific set of modules that compose a specific modules-set of any LF. Each of these BFs can be considered a distinct FBF.

The main difference between an LF and an inert micro/macro-object is that LF has these additional layers of BPI flow (including the specific BI flows) between its subcomponent QPs (as all QPs that compose an inert object have only four horizontal layers of PI flows, a layer for each physical fundamental field: EGF, EMF, WNF and SNF): these additional layers of BPI flows between modules of specific sets may be named BI-flow (horizontal) layers (**BIFLs**).

As each of the four "classical" FPFs has its own specific PI-flow layer (**PIFL**), *it is convenient to extend the definition of the FPF as a FBF, which is defined a bijection, so that each type of FBF has its own horizontal BIFL (different from all the other BIFLs) AND each BIFL has its own associated FBF.* In this view, BFD-PEP association also fits this generalized new definition of FBF, as it represents a pattern of BPI distribution (the quantum "skeleton" of a specific PI flow) that is essentially for LFs to exist in physical form (as BFD-PEP prevents the collapsing of this physical form).

The five FPFs (that act both outside and inside a LF) can be considered (basic) FBFs, as all the four FPFs have those (apparently pre-designed, but also possibly naturally/randomly selected) specific running coupling constants (the 1st rank co-functions based on the 1st rank parameters listed in the previous chapter) that permit LFs to appear and to evolve/survive in a specific time subinterval of the present universal cycle (measured by t_c), as described by the Fine-tuned universe theories, including the Anthropic (Cosmological) Principle. [**59**]. The five FPFs can be indexed from 0 to 4, such as: **FBF[0]** is the BFD-PEP association (intentionally indexed with 0, as it represents the quantum "basement"/ "skeleton" of all the other FBFs,); **FBF[1]** is the EGF; **FBF[2]** is the EMF; **FBF[3]** is the WNF; **FBF[4]** is the SNF.

LFs use all the five FPFs to make decisions (including survival and reproduction), and that is another argument for considering FPFs as "basic" FBFs (with a hardware-like role) that had served, serve or may serve the superior FBFs, which are biological intelligent additional fields/forces (with a software-like role) that can be indexed from 5 (cellular organelles of the cells of LFs) to 12 (societies of LFs), such as:

FBF[5] is associated with the horizontal BIFL of the cellular organelles of all the biological cells (viruses have only this FBF[5] as their DNA, RNA and protective chemical envelopes may all be considered subcellular/acelullar organelles);

FBF[6] is associated with the horizontal BIFL of the (biological) cells (all the unicellular and multicellular organism possess the FBF[6]);

FBF[7] is associated with the horizontal BIFL of the biological tissues (only the multicellular organisms possess the FBF[7]);

FBF[8] is associated with the horizontal BIFL of the biological organs (only some multicellular organisms possess the FBF[8]);

FBF[9] is associated with the horizontal BIFL of the biological systemic/apparatus (only the advanced multicellular organisms possess the FBF[9]);

FBF[10] is associated with the horizontal BIFL of the systemic/apparatus-based organisms (only the advanced multicellular organisms possess the FBF[10], including multicellular plants and animals from worms to humans);

FBF[11] is associated with the horizontal BIFL of the systemic/apparatus-based social organisms (only the relatively advanced multicellular organisms possess the FBF[11]);

In a LF, PI and BI also currently move between *different* horizontal BIFLs: this vertical inter-layer PI/BI-flows are essential for the LF decision making (including survival). This mixture of horizontal and vertical BPI flows in a LF is analogous to the electrograviton model (EGM) that proposes an associated eg for each dimensional frame, so that EGF keeps RU unitary in any dimensional frame of reference.

If EGM will prove to be true, then it is very plausible for quantum G to be much larger at microscopic scales (micro / nano / angstrom scales) and it is also very probable that the predicted SGF manifested at these microscopic scale to play a crucial role in the stability/surviving of the LFs. This (hypothetical) microscopic SGF has the potential to change the "warm-wet and noisy" paradigm (possible prejudice) of the biological brain [**60**] and make quantum coherence existence much more probable and frequent in all the (biological) cells (including the neurons) with potential huge impact in biology.

All LFs can be considered *biological agents* (**BAs**) that generate and manipulate a set of FBFs to make decisions (including survival and reproduction). Inert objects (including all QPs) can also be considered physical-agents (**PAs**) that generate and manipulate only the four FPFs to determine (generally automated, preprogrammed) decision-like reactions. BAs can all be considered swarms of PAs that can generate and manipulate at least one superior FBF[5-12] besides the five basic FBFs[0-4]: that is why a generalized concept of *the bio-physical agent(s)* (**BPAs**) is suggested.

LFFH also proposes a triple extended synonymy between intelligence, consciousness and RU (operation system-like) software (that may be "stored" in the inner structure of all spacetime which may be the source of PI and probably also the source of BI): all the FBFs [0-12] can be considered twelve different forms of manifestation of this cosmic intelligence/consciousness/software (universal operation system), as the quantity and quality of this software can both be measured by the number of horizontal and vertical layers of super-organization of that BA/PA (the Earth biosphere has twelve horizontal BIFLs corresponding to the FBFs [0-11], which are strongly interconnected by vertical BPI bidirectional flows). *LFFH also supports the newly proposed theories of quantum consciousness, like the Hameroff-Penrose "Orch OR (orchestrated objective reduction)" theory [**61**,**62**], in which human consciousness (HC) is considered to derive from a "proto-conscious" quantum structure of reality.*

In a LF, FBFs[5-11] are hierarchically superior to FBFs[0-4], as they coordinate FBFs [0-4] so that to maximize the mean lifetime of those LFs (as this is the main target of all types and levels of biological volition and memory). Apparently, in an LF, FBFs[5-11] coordinate only EGF and EMF (as WNF and SNF don't have an important time-transverse role, BUT they have a very important time-longitudinal role, as the nuclear stability of atoms that compose a LF is vital for the stability/survival of that LF, such as SNF and WNF can be considered the quantum "skeleton" of any chemical structure of a LF, based on BFD-PEP "foundation", which is indexed as FBF[0]). The fact that FBFs[5-11] coordinate EMF and EGF inside a LF to efficiently to increase the mean lifetime of that LF (by "fighting" any SNF/WNF "side effects") is another argument for the informational superiority (as a coordinator) of FBFs[5-11] versus FBFs[0-4].

FBFs[5-11] may also offer an elegant (additional) explanation to the hierarchy problem in physics, as they may fill the huge "gap" of ~40 orders of magnitude between the EMF and EGF strengths and cancel the "huge" character of this apparent "gap": any LF has the capacity to transform a SNF/WNF/EMF stimulus into an EGF (decisional) response and vice versa (except that apparently only humans have the capacity to manipulate volitionally the SNF and WNF) and to coordinate FBFs[0-4] by using FBFs[5-11]. Using FBFs[5-11], LFs on Earth have managed to create a

biosphere that is extended to a scale of $\boxed{l_{bs} \cong 10^7 m}$ (the size scale of the equatorial diameter of the Earth), a biosphere which permanently integrates BPI flows of FBF[0-4] to FBF[5-11] (by converting any type of PI to any type of BI and vice versa) in order to keep its stability and survival on the planet, but also to extend in our solar system and even beyond. Additionally, our biosphere has the potential capacity to fill with LFs (at least) a significant part of our solar system (using humanity as a vector of spreading) which makes biosphere extendable to scale of $l_{bs(\max)} \cong 10^{13} m$ (the size scale of the equatorial diameter of our Solar System) in the distant future.

LFFH also considers very plausible that not only FBFs[0-5], but all FBFs[0-11] have their origin in the pre-Big-Bang singularity, probably pre-designed pre-coded in the BPI matrix of that singularity.

If a complex extended network of BAs will exist in a specific (finite) time interval of the universal cycle (measured by t_c) and on a finite but sufficiently large number of planets (spread in the entire OU, as a global OU biosphere), then a significant degree of spatial, temporal and informational superposition can be considered between our biosphere and OU: in the present, our biosphere uses humanity as a vector that can receive signals even from the margins of the OU, take decisions and also emit signals to all the OU.

IX.   FINAL CONCLUSIONS

This TMU offers a new interpretation to the large numbers coincidence(s) which is essentially different from Dirac's Large Numbers hypothesis and offers a couple of potential valid updates (including new explanations and predictions) for the Standard Model of particle physics: mbl-TH, DRH, EGM (based on DRH), mGH, CCUH and LFFH. *This TMU was motivated and created from the author's strong conviction that SM cannot evolve and become a "mature" TOE without fully explaining the existence of LFs.*

X.   ACKNOWLEDGMENTS

XI.   REFERENCE

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