A "Mirrored" Universe (toy-)Model (MUM) based on a relative big G, a variable quantum big G and a finite mass ambitus of our universe

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DOI: 10.13140/RG.2.2.35738.18885

Article version: 1.0 (21.10.2019) (no matter this current paper version, its latest variant can be always downloaded from this URL; version 1.0 released on 21.10.2019)

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0. Abstract (with main abbreviations used in this paper)

This paper proposes a simple "Mirrored" Universe (toy-)Model (**MUM**) based on a relative big G (Newtonian gravitational constant [**G**]), a variable quantum big G and a finite mass ambitus of our universe (**OU**), with far reaching implications leading to new paths beyond the Standard model (**SM**) of particle physics (**PP**) and Einstein's General Relativity (**EGR**).

MUM also (empirically) predicts:

(**1**) the total mass of all possible known and unknown life forms (**LFs**) from our observable universe (**ObU**);

(**2**) a very strong quantum gravitational field (**QGF**) acting inside elementary particles (**EPs**);

(**3**) an average non-zero radii of all known EPs;

(**4**) that a nucleon (proton/neutron) and generally an atomic nucleus can be regarded as a binary logarithmic "map" of OU AND OU can be considered a binary exponential map/expansion of a standard nucleon or atomic nucleus;

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1. The concept of relative big G G_{rel}

The relative big G G_{rel} concept definition. Let us consider the special case of a Newtonian gravitational force $\boxed{F_g = G \cdot \frac{M \cdot m}{r^2}}$ between one large mass (**M**) (of a relatively heavy physical object [**PO**]) and one (relatively) much smaller mass (**m<<M**) (of a relatively lighter PO), with mass ratio $\boxed{\phi_{rel} \overset{def.}{=} M / m}$ and both POs (defined by M and m) being considered point-like in respect to the distance r between those two distinct POs. Because both POs are composed of elementary particles (**EPs**), let us consider the even more special case $\boxed{F_{g1} = G \cdot \frac{M \cdot m_{EP}}{r^2}}$, with $\boxed{\phi_{rel} \overset{redef.}{=} M / m_{EP}}$. As all EPs composing that larger PO (with mass $M = \sum m_{EPs} >> m_{EP}$) are concentrated in an almost point-like region (**PLR**) (when compared to the distance r between those two distinct POs), **the relatively "isolated" EP (with mass $m_{EP} << M$) may "subjectively" experience a (subjectively) much larger relative gravitational force/field (relGF) with any of its "clone-EPs" with mass $m_{EP(M)}$ located in that PLR (and composing that larger M): this relGF has a strength measured by $\boxed{G_{rel} \overset{def.}{=} \phi_{rel} \cdot G}$, with $\boxed{\phi_{rel} \overset{redef.}{=} M / m_{EP(M)}}$, so that $\boxed{F_{g2} = G_{rel} \cdot \frac{m_{EP(M)} \cdot m_{EP}}{r^2} = F_{g1}}$: even if the force remains the same (because $F_{g2} = F_{g1}$), the isolated EP (with mass m_{EP}) may thus "subjectively" experience a much stronger GF (named "relGF" with strength defined by G_{rel}) when gravitationally "linking" with one of its "sister-EPs" (with mass $m_{EP(M)}$) relatively "strictly" located in that "targeted"-PLR.**

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Important note. The generic ratio $\boxed{G_{rel} / G \overset{(def.)}{=} \phi_{rel}}$ (defining the strength of relGF) is thus directly related to the (generic) mass ratio/"ambitus" $\boxed{M / m_{EP(M)} \left(\overset{redef.}{=} \phi_{rel} \right)}$ of various POs from our universe (OU) so that $\boxed{G_{rel} / G \overset{(def.)}{=} M / m_{EP(M)}}$. Estimations of ϕ_{rel} maximums as related to some maximum mass ambituses allowed in OU. In the case of the largest (and heaviest) conceivable star known to be allowed in our (observable) universe (with mass $M_{S(\max)} \cong 10^2 M_{Sun} \in \left[\overset{\cong}{} 120 M_{Sun}, \overset{\cong}{} 300 M_{Sun} \right]$ and mass of our Sun $M_{Sun} \cong 10^{30} kg$) versus a single electron neutrino (**en**) (the lightest known EP, with en mass estimated as $m_{en} \cong 1eV / c^2$), one can estimate $\boxed{\phi_{rel(\max 1)} \overset{def.}{=} G_{rel(\max 1)} / G \left(\overset{estim.}{=} M_{S(\max)} / m_{en} \right) \cong 10^{68}}$.

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In the case of the total mass of the observable universe (**ObU**) (with $M_{ObU} \cong 1.5 \times 10^{53} kg$) versus the same (single) en, one can estimate

$$\phi_{rel(\max 2)} \overset{def.}{=} G_{rel(\max 2)} / G\left(\overset{estim.}{=} M_{ObU} / m_{en} \right) \cong 10^{88}.$$

Important observation. Interestingly enough, both $\phi_{rel(\max 1)} \cong 10^{68}$ and $\phi_{rel(\max 2)} \cong 10^{88}$ **are in quite "round" exponential ratios with the maximum field/force (F) strength ambitus of ObU defined by the strengths ratio (which is truly fundamental for OU!)**

$$N_F \overset{def.}{=} \phi_{F(\max)} = \alpha_S / \alpha_G \cong 1/\ \alpha \cdot \alpha_G\ \cong 5.71 \times 10^{44}$$

between the strong nuclear field (SNF) (with strength at rest measured by the SNF coupling constant $\alpha_S \cong 1$ **) and gravitational field (GF) (with strength at rest measured by the GF coupling constant** $\alpha_G \cong 10^{-45}$ **): more exactly,** $\phi_{rel(\max 1)} \cong N_F^{3/2}$ and $\phi_{rel(\max 2)} \cong N_F^{2}$, with $\alpha \cong 1/137$ being the electromagnetic field (**EMF**) coupling constant at rest (also known as the fine structure constant [**FSC**]).

Other important estimations (1). Additionally, the maximum theoretical mass limit for the largest possible planet (above which that theoretical planet gravitationally collapses into a small star) is $M_{P(\max)} \cong 80 M_{Jup} \cong 1.5 \times 10^{29} kg \cong 10^{-1} M_{Sun}$, with $M_{Jup} \cong 1.9 \times 10^{27} kg$ being planet Jupiter's mass): this implies $\phi_{rel(P)} \cong 10^{65} \cong N_F^{\cong 3/2}$.

Other important estimations (2). Additionally, $\phi_{rel(tq)} = m_{tq} / m_{en} \cong 10^{11} \cong N_F^{1/4}$ and $\phi_{rel(Higgs)} = m_{Higgs} / m_{en} \cong 10^{11} \cong N_F^{1/4}$ with $m_{tq} \cong 173 GeV / c^2$ being the rest mass of the top quark (which is the heaviest known EP) and $m_{Higgs} \cong 125 GeV / c^2$ being the rest mass of the Higgs boson (which is the 2nd heaviest known EP). **Important note. The fact that the mass ambitus of all known EPs (measured by** $m_{tq} / m_{en} \cong 10^{11}$**) is so close to** $N_F^{1/4}$ **may have a very important meaning/significance, as we shall explain later in detail.**

Other important estimations (3). Additionally, $\phi_{rel(p)} = m_p / m_{en} \cong 10^{9} \cong N_F^{1/5}$ with $m_p \cong 938 MeV / c^2$ being the rest mass of the proton (which is the most frequent natural occurring subatomic composite particle [**CP**] in OU, with m_p very close to that of the neutron's, which is the 2nd most frequent natural occurring subatomic CP in OU).

Other important estimations (4). Additionally, $\phi_{rel(Pl)} = m_{Pl} / m_{en} \cong 10^{28} \cong N_F^{2/3}$ with $m_{Pl} \cong 0.02 mg$ being the Planck mass (which is considered the approximate inferior mass limit of the lightest possible black hole aka micro/mini black hole or quantum mechanical black holes).

Important remark. Interestingly enough to be mentioned, m_{Pl} has a value which is higher but relatively close to the mass spectrum of Eukaryotic (biological) cells (**ECs**) (including the egg cell aka human ovum) which ECs have a relatively large mas spectrum and size spectrum that is centered around $m_{EC} \cong 1 ng \cong 10^{-9} kg$ [URL] (corresponding to $\phi_{rel(EC)} = m_{EC} / m_{en} \cong 10^{27} \cong N_F^{0.6}$) and $d_{EC} \cong 10 \mu m \cong 10^{-5} m$. **Even more interestingly**, the mass spectrum of prokaryotic (biological) cells (**PCs**) (identified with Archaea and Bacteria) which PCs have a mass spectrum centered around $m_{PC} \cong 1 pg \cong 10^{-12} kg$ [URL] corresponding to $\phi_{rel(PC)} = m_{PC} / m_{en} \cong 10^{21} \cong N_F^{1/2}$. Equally interesting is that the "N_F mass domain" corresponding to masses around $N_F \cdot m_{en} \cong 10^{9} kg$ don't correspond to any known significant class of non-living POs, BUT $N_F \cdot m_{en} \cong 10^{9} kg$ has a value relatively close to the estimated mass of planet Earth's biosphere $m_{BS} \cong 10^{12} kg$ [URL] with a correspondent $\phi_{rel(BS)} = m_{BS} / m_{en} \cong 10^{48} \cong N_F^{\cong 1.1}$; also interestingly, multicellular (**MC**) life forms (**LFs**) from Earth with a domain of body masses centered around $m_{MC} \cong 1 kg$ correspond to $\phi_{rel(MC)} = m_{MC} / m_{en} \cong 10^{35} \cong N_F^{\cong 0.8}$ which is

approximately (and logarithmically!) symmetric to $N_F^{\cong 1.1}$ when choosing N_F as a (logarithmic) "symmetry axis".

Given the same set of mass-magnitude orders of OU in the LF domain of masses, a small virus (which is classified as a limit between non-living and living POs of our ObU) like the Brome mosaic virus with $m_{vir} \cong 1kg$ has an associated

$$\phi_{rel(vir)} = m_{vir} / m_{en} \cong 10^{15} \cong N_F^{\cong 0.35}$$

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2. A "Mirrored" Universe (toy-)Model (MUM) based on the relative big G concept, a variable quantum big G and a finite mass ambitus of our universe

Statement no. 1a (Stat1a) of MUM. The main classes of POs in our observable universe (ObU) tend have their masses around values of $\cong N_F^{\,x} \cdot m_{en}$, with x≤2 being a small integer or a generic fraction f=n/m (with n and m also being small integers): this is a predicted/anticipated uniform logarithmic mass distribution of the known main classes of POs.

Important note. As NO other specific/notable class of POs occupies the "mass domain" centered around $\cong N_F^{1/2}$ and $\cong N_F$, all life forms (**LFs**) mentioned above are the only significant worth to mention POs that interestingly fill those empirical "gaps" left by non-LF POs, when applying Stat1a.

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Statement no. 1b (Stat1b) of MUM. Based on the previous estimations, **LFs are stated (and predicted by empirical induction!) to have a logarithmically-symmetrical distribution around N_F of their associated/corresponding ϕ_{rel}**. **Prediction**. Based on this empirical "symmetry principle" proposed by Stat1b, MUM predicts that, if $\phi_{rel(vir)} \cong N_F^{\,0.35} \cong N_F^{\,1+(-0.65)}$, then there may be real or potential biospheres in OU (in other possibly LF-friendly solar systems) which may reach $\phi_{rel(BS)(\max)} \cong N_F^{\,1+(0.65)} \cong N_F^{\,1.65}$ corresponding to an approximated maximum BS mass (locally or globally extended in OU)

$$m_{BS(\max)} \cong N_F^{\,1.65} \cdot m_{en} \cong 10^{38} kg \cong 10^{26} m_{BS} \cong 10^{8} M_{Sun}$$

, which predicts that ObU may contain a total amount of LFs with a total mass 10^8 times larger than our Sun's mass. This prediction of MUM is in relative agreement with some new so-called "surprising" (and very optimistic!) estimations of the relative high occurrence of Earth-like planets/exoplanets in ObU [URL0a, URL0b, URL0c, URL0d, URL1, URL2, URL3, URL4].

The next figure (graph) shows the almost linear distribution of x exponents of generic mass $m_x \cong N_F^{\,x} \cdot m_{en}$ of the main classes of non-living and living PO of our ObU.

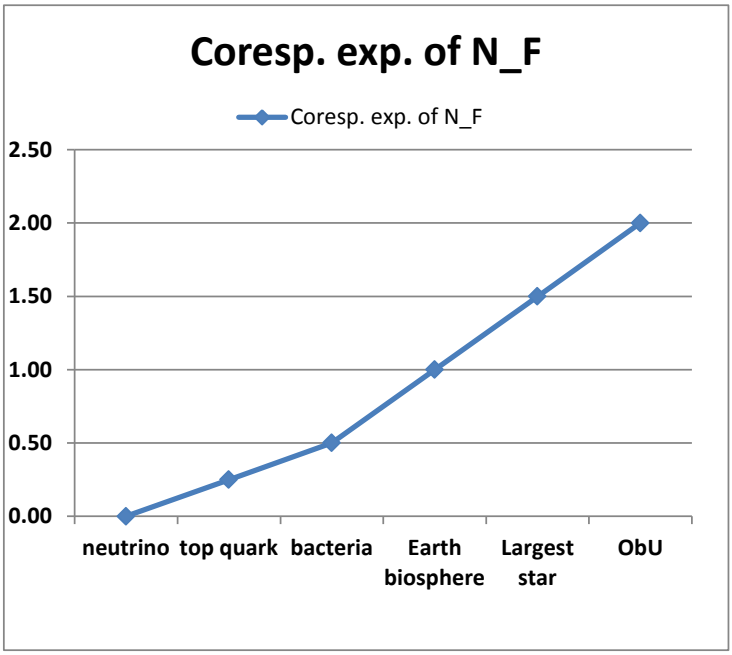

Figure 1. The almost linear distribution of x exponents of generic mass $m_x \cong N_F^{\,x} \cdot m_{en}$ of the main classes of non-living and living PO of our ObU.

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Checkpoint conclusion. Both Stat1a and Stat1b (combined with the other previous observations from this paper) indicate/suggest that LF may somehow be deeply encoded in the laws of OU. The author has also dedicated other past papers to this possible "life code" "encrypted" by OU [**1**, **2**, **3**, **4**, **5**, **6**, **7**, **8**, **9**].

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Statement no. 2 (Stat2) of MUM (work hypothesis). Based on $\phi_{rel(\max 2)} = G_{rel(\max 2)} / G = M_{ObU} / m_{en} \cong 10^{88}$ (as derived from the general G_{rel} concept, together with its notes, observations and estimations) and the maximum mass ambitus of our ObU $N_U \overset{def.}{=} N_F^{\,2} \cong 3.26 \times 10^{89}$ (with $\phi_{rel(\max 2)} \cong N_U$), MUM proposes a hypothetical ("running"/variable) quantum big G G_q λ defined to vary inverse-proportionally with the length scale λ and to reach $G_{rel(\max 2)} \cong N_U \cdot G$ at Planck length scale

$l_{Pl} \cong \sqrt{\hbar G / c^3} \cong 10^{-35} m$, **so that** $G_q(\lambda) \cong N_U^{l_{Pl}/\lambda} \cdot G$ **and** $G_q(l_{Pl}) \cong N_U \cdot G = G_{rel(\max 2)}$. $G_q(\lambda)$ can be also rewritten as a function of a variable (photonic) energy scale $E = hc/\lambda$ and based on Planck energy $E_{Pl} = \sqrt{\hbar c^5 / G} \cong 1.2 \times 10^9 GeV$ so that $G_q(E) \cong N_U^{E/E_{Pl}} \cdot G$. Based on $G_q(E)$, MUM proposes a variable quantum GF coupling constant $\alpha_{Gq}(E) = G_q(E) \cdot m_e^2 / \hbar c \cong N_U^{E/E_{Pl}} \cdot G m_e^2 / \hbar c$, which grows in a "smooth" exponential manner which appears linear when graphed in a logarithmic scale (**see the next figure**).

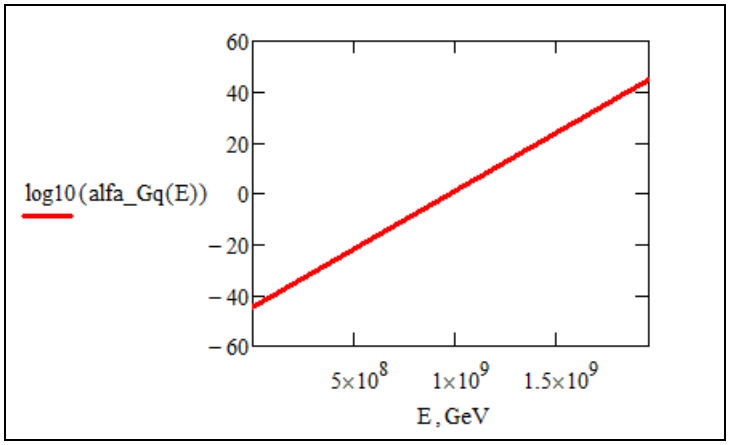

Figure 2a. The (logarithmic) graph of $\log_{10}[\alpha_{Gq}(E)]$ **for** $E \in E_{en}, E_{Pl}$ **(expressed in GeV units), with** $E_{en} = m_{en}c^2$ **being the rest energy of the electron neutrino.**

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"Assembling" on the same graph the running coupling constants of all known fundamental physical fields (FPFs): SNF, the weak nuclear field (WNF), EMF and the MUM-proposed quantum GF with strength defined by $\alpha_{Gq}(E)$ **).**

SNF. The running coupling constant of the strong nuclear field (**SNF**) $\alpha f_S(E) \cong \frac{2\pi}{7 \ln E / E_{SNF}}$ [**10**] (with a variable energy scale $E >> E_{SNF}$) is determined in quantum chromodynamics (**QCD**) (also) by using the beta function, with $E_{SNF} \cong 210 \pm 40\ MeV$ being the QCD energy scale of quark confinement as determined experimentally. [**11**]

WNF. The running coupling constant of the weak nuclear field (**WNF**) $\alpha f_W(E) \cong \frac{E_W^2 G_F / \hbar c^3}{e^{E_W/E}}$ (with a variable energy scale E) includes the rest energies of the W/Z bosons (which are the propagators of the WNF) and is also based on the Fermi coupling constant $G_F / \hbar c^3 \overset{exp.}{\cong} 1.1663787 \times 10^{-5} GeV^{-2}$ (with $G_F \cong 1.43585 \times 10^{-62} Jm^3$), which can be indirectly determined by measuring the muon lifetime experimentally: $E_W = m_W c^2$ is the rest energy of the $W^{+/-}$ boson with rest mass m_W [**12**,**13**,**14**,**15**] [**11**].

EMF. The running coupling constant of EMF $\alpha_f(E) \cong \frac{\alpha}{1 - \frac{\alpha}{3\pi} \ln[E / E_e]^2}$ is determined in quantum electrodynamics (**QED**) by using the beta function, with $E_e = m_e c^2 \cong 0.51 MeV$ and $\alpha \cong 1/137$ being the electromagnetic field (**EMF**) coupling constant at rest (also known as the fine structure constant [**FSC**]) **[16,17][11].**

We may now assemble all the previously-defined FPF-coupling constants in a single graph (see the next figure).

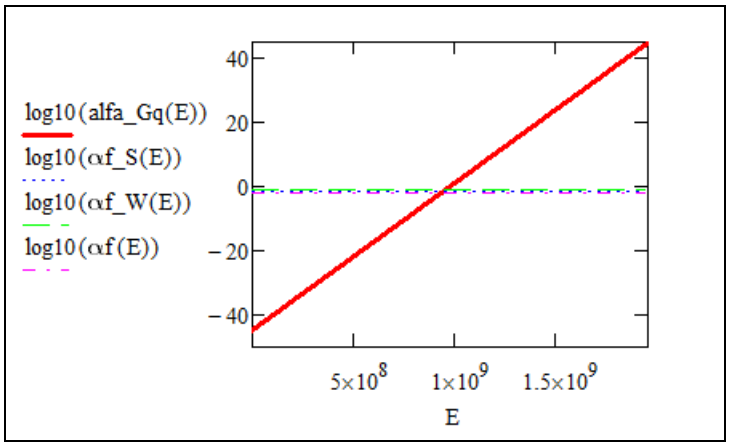

Figure 2b. The combined (logarithmic) graph of $\log_{10}[\alpha_{Gq}(E)]$, $\log_{10}[\alpha f_S(E)]$, $\log_{10}[\alpha f_W(E)]$ **and** $\log_{10}[\alpha f(E)]$ **for** $E \in E_{en}, E_{Pl}$ **(expressed in GeV units), with** $E_{en} = m_{en}c^2$ **being the rest energy of the electron neutrino.**

Important note. From the previous figure, one may easily observe that the strength-ratio between quantum GF and the other three FPFs invert/"twist"/inter-switch around $E_{inv} \cong 1 \times 10^9 GeV$**. Interestingly,** E_{inv} **corresponds to a length scale** $l_{inv} \cong hc / E_{inv} \cong 10^{-24} m$ **which is approximately 100 times lower than the upper limit of the**

hypothesized non-zero electron diameter (size) $l_{e(\sup)} \cong 10^{-22} m$ (as estimated by using "trapped" electrons by Penning traps), so that $l_{inv} \cong 10^{-2} \times l_{e(\sup)} \cong 10^{11} \times l_{Pl}$.

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Statement no. 3a (Stat3a) of MUM (as based on Stat2). MUM states that the so-called elementary particles (EPs) (as theorized and estimated by the Standard model [SM]) are NOT literarily zero-radii "point-like" entities (as they are currently/presently/"standardly" modeled by the mainstream Quantum field theory [QFT]), BUT EPs are ACTUALLY spacetime "bubbles"/(subquantum) deformations with average (av) non-zero radii $l_{EP(av)} \cong l_{inv} \cong 10^{11} \times l_{Pl} > 0$ **and volumes** ${l_{EP(av)}}^3 \cong {l_{inv}}^3 > 0$ **implicitly.**

Important note. MUM thus predicts a quantum GF that may be the strongest FPF at Planck scale (a scale at which SNF is predicted to have the lowest strength, due to asymptotic freedom of QCD): this is a MIRROR-LIKE INVERSION of macrocosmic FPFs-strengths-ratios when projected in the microcosm defined here as the length/scale domain under the MUM-predicted average size of an EP $l_{EP(av)} \cong l_{inv} \cong 10^{11} \times l_{Pl} > 0$, which is much smaller (by ~9 dimensional orders) than the **proton charge diameter** $d_p = 2r_p \cong 1.7\, fm \cong 10^{20} l_{Pl}$. **Remark. The fact that the electron is estimated by MUM as being ~10^9 times smaller than the proton may also indicate a very strong FPF (identified by MUM with this hugely strong quantum GF!) acting inside the electron and maximally compacting it.**

An "inductive" argument (1) in favor of EPs with non-zero radii/sizes, which argument is based on a strong link between Einstein's General Relativity (EGR) and quantum chromodynamics (QCD) first proposed in author's past "Simple gravitonic universe model" (SGUM) [18]. "It is well known/demonstrated that **~99%** of a nucleon (proton [**p**] or neutron [**n**]) rest mass $m_{p/n}$ (which $m_{p/n}$ is actually the inertial mass of a nucleon measured by an observer which is "at rest" in respect to that nucleon) IS IN FACT produced by BOTH, primarily, the kinetic energy of their subcomponent gluons (the quanta of the strong nuclear field [**SNF**], which gluons bind "nucleonic" up and down quarks together, by the so called quantum chromodynamics binding energy which is actually the SNF energy) and, secondarily, the kinetic energy of quarks: tertiarly, only the rest of ~1% of $m_{p/n}$ is due to the rest masses of all its subcomponent quarks, HOWEVER all $99\%+1\%\ m_{p/n}$ couples gravitationally (because the gravitational mass [URL2] and inertial mass of a nucleon were experimentally proved to be equal, at least in the error limit of the experiments) SO THAT it is almost obvious that the movement of both gluons and quarks actually produces a spacetime (**ST**) micro-deformation (micro-curvature [**micro-C**/**micro-STC**] with NON-ZERO RADIUS definable by a set of geodesics) AND it is that micro-STC which generates (micro-)gravity which SHOULD NOT be treated as a real force, but only the consequence of STC, as it is treated by the successful Einstein's General Relativity (**EGR**): in other words, EGR and quantum chromodynamics (**QCD**) (the quark-gluon model of hadrons) are compatible and EGR somehow anticipated QCD by also predicting STCs not only at large macrocosmic scales (macro-STCs), but also micro-STCs at microcosmic scales. In the case of Newtonian gravitational force $F_g = G\frac{m_1 m_2}{r^2}$ for example, although both m_1 and m_2 are considered point-like (in respect to the distance r between those two masses), each mass m_1, m_2 is approximately the sum $\sum m_{p/n}$ of all its subcomponent nucleons, because the electrons (with rest mass $m_e \cong m_{p/n}/1837$) have a very small contribution (<1/1000) of the total rest energy (implicitly mass) of atoms (with nucleons at rest): it is also clear that any macro-STC generated by a macrocosmic mass may be modeled as the resultant of all micro-STCs generated by each nucleon (subcomponent of that mass) in part.". **By inductive hypothesis, SGUM actually extended this EGR-QCD-related observation on all EPs with non-zero rest masses (nzrm), by stating that nzrm-EPs actually "hide" subquantum (possibly gravitonic) movement which produce micro-STC, which STC couple gravitationally and generate the nzrm phenomenon (inertial/gravitational mass).**

Another "inductive" argument (2) in favor of EPs with non-zero radii/sizes. The perfect spherical shape of the electron cloud [URL1, URL2, URL3] may be also an indirect proof of the huge strength of this MUM-proposed quantum GF acting at scales close to Planck scale.

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Statement no. 3b (Stat3b) of MUM (as based on Stat3a). MUM also states that, given the hypothesized (/predicted) very strong quantum GF (vs-QGF) at the (almost infinitesimal) Planck scale, EPs are actually quantized micro-black holes (mBHs), with the simple existence of EPs being actually the indirect proof of this vs-QGF at that Planck scale.

Important note. The author has many past papers which launched the thesis that EPs are actually spacetime deformations with non-zero radii/sizes, with various arguments [19, 20-"DVTM", 21-"eSR" (long variant), 22-"eSR" (short variant), 18-"SGUM"]: additionally, MUM and SGUM predict similar sizes for EPs.

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Important observation. MUM also emphasizes the very interesting numerical closeness between the SNF-over-EMF

strength-ratio $\alpha_S / \alpha \cong \alpha^{-1} \cong 137$ **(with SNF being the strongest FPF in the proton, at** $d_p \cong 1.7\,fm$ **scales and EMF being the weakest at that same** d_p **length scale) AND the EMF-to-GF base-2/binary logarithmic strength-ratio** $\log_2 \alpha / \alpha_G \cong \log_2 4 \times 10^{42} \cong 141.52$ **(with EMF being the strongest FPF at macrocosmic scale and GF being the weakest of that same [macrocosmic] scale): this quasi-equality** $\alpha_S / \alpha \cong \log_2 \alpha / \alpha_G$ **indicates that a nucleon (proton/neutron) and generally an atomic nucleus can be regarded as a binary logarithmic "map" of our universe (OU) AND OU can be regarded as a binary exponential map/expansion of a standard nucleon or atomic nucleus.**

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3. The main conclusions of this paper

1) **Final conclusion (1). In MUM, EPs can be thus regarded as micro-universes in which the strongest FPF may be actually a very strong quantum GF (when judged from the estimated average diameter of an EP down to Planck length) and the weakest FPF may be a unified EMF-WNF-SNF field aka "Grand unified theory" (GUT) field (which may play the role of the weakest gravity-like FPF, similarly to gravity being the weakest force in the macro-universe).**
2) **Checkpoint conclusion (2). In other words, at its macrocosmic scales, our universe (OU) can be regarded as a cosmic "simulation" of the Planck scale and vice versa: this is a "mirrored"/"self-reflected" universe în which the macrocosmic is the inverted "reflection" of microcosm and vice versa.**
3) **A nucleon (proton/neutron) and generally an atomic nucleus can be regarded as a binary logarithmic "map" of OU AND OU can be regarded as a binary exponential map/expansion of a standard nucleon or atomic nucleus.**

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