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Is reduced Planck's constant- an outcome of electroweak gravity?

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Abstract: To understand the mystery of final unification, in our earlier publications, we proposed that there exist three atomic gravitational constants associated with electroweak, strong and electromagnetic interactions. During cosmic evolution, if one is willing to give equal importance to Higgs boson and Planck mass in understanding the massive origin of elementary particles, then it seems quite logical to expect a common relation in between Planck scale and Electroweak scale. Based on these two points, we noticed that, electroweak field seems to be operated by a primordial massive fermion of rest energy 585 GeV. It can be considered as the zygote of all elementary particles and galactic dark matter. H-bar seems to be a characteristic outcome of unified electroweak gravity. Electron rest mass seems to be a characteristic outcome of electroweak and strong gravity. Proton rest mass seems to be a characteristic outcome of electroweak, strong and electromagnetic gravity. Recently observed 3.5 keV photon seems to be an outcome of annihilation of charged baby lepton of rest energy 1.75 keV. Interesting point to be noted is that, Schwarzschild radius of electron is 0.48 nanometer and it needs further investigation with respect to emerging nano-science and technology. Proceeding further, by considering electromagnetic and weak gravitational constants, neutron life time can be understood.

Key words: Four gravitational constants; Electroweak fermion; Reduced Planck's constant; Stellar mass limits; 3.5 keV photon; Neutron life time;

Nomenclature	
1) Newtonian gravitational constant $= G_N$	18) Nuclear charge radius $= R_{(Z,A)}$
2) Electromagnetic gravitational constant $= G_e$	19) Schwarzschild radius of $M_w = R_w$
3) Nuclear gravitational constant $= G_s$	20) Schwarzschild radius of $m_e = R_e$
4) Weak gravitational constant $= G_W$	21) Schwarzschild radius of atom $= R_{atom}$
5) Fermi's weak coupling constant $= G_F$	22) Mean stable mass number $= A_m$
6) Electroweak fermion $= M_w$	23) Nuclear binding energy $= B_{(A,Z)}$
7) Reduced Planck's constant $= \hbar$	24) Nuclear binding energy coefficient $= B_0$
8) Speed of light $= c$	25) Coefficients connected with nuclear stability and binding energy $= (k_1, k_2)$
9) Strong coupling constant $= \alpha_s$	26) Mass limit of stellar object $= M_X$
10) Elementary charge $= e$	27) Characteristic ratio associated with charged leptons $= \sqrt{\frac{4\pi\varepsilon_0 G_e m_e^2}{e^2}} \cong \gamma$
11) Mass of proton $= m_p$	28) Mass of charged baby lepton$= (m_{xl})^{\pm}$
12) Mass of neutron $= m_n$	29) Neutron life time $= t_n$
13) Mass of electron $= m_e$	
14) Mass of Up quark $= m_u$	
15) Mass of Down quark $= m_d$	
16) Bohr Radius $= a_0$	
17) Schwarzschild radius of $m_p = R_p$	

1. Introduction

Even though celestial objects that show gravity are confirmed to be made up of so many atoms, so far scientists could not find any relation in between gravity and the atomic interactions at quantum gravity level [1,2]. Black hole temperature point of view [3], strong interaction point of view [4-7] and electroweak interaction point of view [8], scientists found very interesting similarities in between gravity and quantum phenomena. Quantum cosmology point of view [9] and nuclear quantum gravity point of view [10-20], authors could develop workable ideas, concepts and relations. On a whole, workability is still lagging. It clearly indicates that, there is something wrong in our notion of understanding or there is something missing in developing the unified physical concepts and needs a critical review at fundamental level. In this context, we hope that, electroweak scale [21,22,23] can certainly yield useful stuff.

2. Motivating concepts

To develop new and workable ideas, we wish to highlight the following points.

1) During cosmic evolution, if one is willing to give equal importance to Higgs boson and Planck mass in understanding the massive origin of elementary particles and observed matter [24,25], then it seems quite logical to expect a common relation in between Planck scale and Electroweak scale.
2) Whether particle's massive nature is due to electromagnetism or gravity or weak interaction or strong interaction or cosmic dust or dark matter [26] or something else, is unclear.
3) Without understanding the massive nature, it is not reasonable to classify the field created by any elementary particle.
4) All the four interactions seem to be associated with $(\hbar)$.
5) Nobody knows the mystery of $(\hbar)$ which seems to be a basic measure of angular momentum [27,28,29,30].
6) Nobody knows the mystery of existence, stability and behavior of 'proton' or 'electron'.
7) 'Mass' is a basic property of space-time curvature and basic ingredient of angular momentum.
8) Atoms are mainly characterized by protons and electrons.
9) 'Free neutron' is an unstable particle.

3. Basic assumptions

1) There exists a characteristic electroweak fermion of rest energy [18], $M_w c^2 \cong 584.725$ GeV.
2) M_w can be considered as the zygote of all elementary particles.
3) Fermi's weak coupling constant (G_F) [29,30,31] can be considered as the basic unified coupling constant.
4) Each atomic interaction is associated with a characteristic gravitational coupling constant.

$G_e \cong 2.374335\times10^{37}\ \text{m}^3\text{kg}^{-1}\text{sec}^{-2}$
$G_s \cong 3.329561\times10^{28}\text{m}^3\text{kg}^{-1}\text{sec}^{-2}$
$G_w \cong 2.909745\times10^{22}\ \text{m}^3\text{kg}^{-1}\text{sec}^{-2}$
$G_N \cong 6.679855\times10^{-11}\ \text{m}^3\text{kg}^{-1}\text{sec}^{-2}$

4. Characteristic unified relations

Based on the above points, we propose the following new and workable relations.

$$\hbar c \cong G_w M_w^2 \cong \sqrt{G_F\left(\frac{c^4}{4G_w}\right)} \quad \Rightarrow \hbar \cong \frac{G_w M_w^2}{c} \cong \sqrt{\frac{G_F c^2}{4G_w}} \tag{1}$$

where $\left(\frac{c^4}{4G_w}\right) \cong 6.9401\times10^{10}$ N is the characteristic force associated with electroweak interaction.

$$m_e \cong \left(\frac{G_w}{G_s}\right) M_w \tag{2}$$

$$m_p \cong \left(\frac{G_s}{G_w}\right)\left(\frac{G_s}{G_e}\right) M_w \cong \left(\frac{G_s^2}{G_w G_e}\right) M_w \tag{3}$$

$$\frac{m_p}{m_e} \cong \frac{G_s^3}{G_w^2 G_e} \tag{4}$$

5. Specific unified relations connected with G_N

With reference to Newtonian gravitational constant [32-39],

$$\left(\frac{m_p}{m_e}\right)^{10} \cong \left(\frac{G_w}{G_N}\right) \tag{5}$$

$$\exp\left(\frac{1}{\alpha_s^2}\right) \cong \left(\frac{G_w}{G_N}\right) \quad (6)$$

where α_s =Strong coupling constant [29,31]

$$\frac{m_p}{m_e} \cong \left(\frac{G_s}{G_e^{1/3} G_N^{2/3}}\right)^{1/7} \quad (7)$$

6. Specific unified relations connected with nuclear radius and Bohr radius

Characteristic Schwarzschild radius of proton and Schwarzschild radius of atom can be addressed with the following relations.

$$R_p \cong \frac{2G_s m_p}{c^2} \cong 1.2393 \text{ fm} \quad (8)$$
$$= \text{Characteristic nuclear charge radius [40,41]}$$

$$R_{(Z,A)} \cong \left\{Z^{1/3} + \left(\sqrt{Z(A-Z)}\right)^{1/3}\right\}\left(\frac{G_s m_p}{c^2}\right) \quad (9)$$
$$= \text{Nuclear charge radius [42]}$$

$$a_0 \cong \left(\frac{4\pi\varepsilon_0 G_e m_e^2}{e^2}\right)\left(\frac{G_s m_p}{c^2}\right) \cong 5.2918\times10^{-11} \text{ m} \quad (10)$$
$$= \text{Bohr radius of Hydrogen atom [28]}$$

7. Specific unified relations connected with proton-electron mass ratio

With reference to electroweak interaction,

$$R_w \cong \frac{2G_w M_w}{c^2} \cong 6.7494\times10^{-19} \text{ m} \quad (11)$$
$$= \text{Schwarzschild radius of } M_w$$

$$\frac{R_p}{R_w} \cong \left(\frac{2G_s m_p}{c^2}\right) \div \left(\frac{2G_w M_w}{c^2}\right) \cong \frac{G_s m_p}{G_w M_w} \cong \left(\frac{m_p}{m_e}\right) \quad (12)$$

With reference to $R_w \cong 6.7494\times10^{-19}$ m and cconsidering $\left(\frac{m_p}{m_e}\right)$ as a geometric ratio, nuclear radius and atomic radius can be estimated in the following way.

$$R_1 \cong \left(\frac{m_p}{m_e}\right)\left(\frac{2G_w M_w}{c^2}\right) \cong 1.2393 \text{ fm} \quad (13)$$

$$R_2 \cong \left(\frac{m_p}{m_e}\right)^2\left(\frac{2G_w M_w}{c^2}\right) \cong 2.275 \text{ pm} \quad (14)$$

With reference to electromagnetic gravitational constant, Schwarzschild radius of electron can be addressed with,

$$R_e \cong \left(\frac{2G_e m_e}{c^2}\right) \cong 0.48 \text{ nm} \quad (15)$$

Based on relations (14) and (15), identifying R_2 and R_e as characteristic length scales associated with characteristic atomic radius, we noticed that,

$$\sqrt{R_2 R_e} \cong \left(\frac{2\sqrt{G_e G_s} m_p}{c^2}\right) \cong 33.1 \text{ pm} \quad (16)$$
$$\cong R_{atom} \cong \text{Scwarzschild radius of atom [43]}$$

8. Specific unified relations connected with nuclear stability and binding energy

Nuclear mean stability and binding energy [44,45] can be understood with the following two relations.

Nuclear mean stability can be understood with,

$$\left.\begin{array}{l} (A_s)_{mean} \cong A_m \cong 2Z + k_1 Z^2 \\ \text{where } \begin{cases} k_1 \cong 4\left(\frac{G_s^2}{G_e G_w}\right) \cong 4\left(\frac{m_p}{M_w}\right) \\ \cong 0.0064185 \end{cases} \end{array}\right\} \quad (17)$$

Nuclear binding energy can be understood with,

$$B_{(A,Z)} \cong \left\{\begin{array}{l} \left(1 - k_2\sqrt{ZN}\right)A - A^{1/3} \\ -\left(1 + \frac{(A_m - A)^2}{A_m}\right) \end{array}\right\}(B_0 \cong 10.1 \text{ MeV}) \quad (18)$$

$$\left.\begin{array}{l} \text{where, } k_2 \cong 2\sqrt{\frac{G_w}{G_s}} \cong 2\sqrt{\frac{m_e}{M_w}} \cong 0.00189 \\ B_0 \cong \left(\frac{1}{\alpha_s}\right)\frac{e^2}{4\pi\varepsilon_0 R_0} \\ \cong \frac{\left[(2m_u + m_d)c^2 + (m_u + 2m_d)c^2\right]}{2} \cong 10.275 \text{ MeV} \\ \text{where } (m_u, m_d) = \text{Up and Down quark masses [29]} \end{array}\right\}$$

Note-: The numbers $(k_1 \text{ and } k_2)$ can be considered as the characteristic outcomes of the combined effect of strong and electromagnetic coupling constants. With trial-error method, we noticed that, $(k_1, k_2) \cong \left(\frac{(1-\alpha_s)^n}{2n-1}\right)\alpha \cong (0.00644, 0.001892)$ where $n \cong 1, 2$ and $\alpha_s \cong 0.1181$. It needs further study.

9. Specific unified relations connected with stellar mass limits

With reference to strong nuclear gravitational constant and astro-physics point of view [14, 16], by considering nucleon as a characteristic building block, stellar mass limit [46,47] can be understood with a relation of the form,

$$\frac{G_N M_X}{G_s m_n} \cong \sqrt{\frac{G_s}{G_N}} \quad (19)$$

Thus, characteristic stellar mass limit can be estimated with a very simple relation of the form,

$$M_X \cong \left(\frac{G_s}{G_N}\right)^{\frac{3}{2}} (m_n) \cong 9.37 \text{ solar masses} \quad (20)$$

Another interesting relation is,

$$\frac{G_N M_X}{G_s \sqrt{m_n M_w}} \cong \sqrt{\frac{G_s}{G_N}} \quad (21)$$

$$M_X \cong \left(\frac{G_s}{G_N}\right)^{\frac{3}{2}} \sqrt{m_n M_w} \cong 234 \text{ solar masses} \quad (22)$$

With reference to electromagnetic gravitational constant, mass limits of super massive stellar objects can be understood.

10. Applications of G_e in elementary particle physics and astrophysics

A) Understanding the recently observed 3.5 keV galactic photon

Recent galactic X-ray [48,49] studies strongly confirm the existence of a new photon of energy 3.5 keV. So far, its origin is unknown and unclear. In this context, we propose the following alternative mechanism for understanding the origin of 3.5 keV photon.

1) There exists a characteristic charged baby lepton of rest mass,

$$(m_{xl})^{\pm} \cong \sqrt{\frac{e^2}{4\pi\varepsilon_0 G_e}} \cong 1.75 \text{ keV}/c^2 \quad (23)$$

2) With pair annihilation mechanism, (m_{xl}) generates a photon of rest energy 3.5keV
3) With current and future particle accelerators, $(m_{xl})^{\pm} \cong 1.75 \text{ keV}/c^2$ can be generated.

B) Fitting Muon and Tau rest masses

Experimentally observed [29] Muon and Tau rest masses can be fitted in the following way.

$$m_{(\mu,\tau)}c^2 \cong \left\{\left[\gamma^3 + (n^2\gamma)^n \left(\frac{G_e}{G_N}\right)^{1/4}\right]^{\frac{1}{3}} 1.75 \text{ keV}\right\} \quad (24)$$

where,

$\gamma \cong \sqrt{\frac{4\pi\varepsilon_0 G_e m_e^2}{e^2}} \cong 292.187$ and $n = 1$ and 2

For $n=1$, obtained $m_\mu c^2 \cong 106.5$ MeV

$n=2$, obtained $m_\tau c^2 \cong 1781.5$ MeV.

At $n=3$, a new heavy charged lepton of rest energy 42.2 GeV can be predicted.

11. Specific unified relations connected with (G_e, G_s, G_w, G_N)

Based on the above relations and applications, we propose the following three relations.

$$\frac{M_w}{m_e} \cong \frac{G_w^{5/2} G_e^{5/3}}{G_s^4 G_N^{1/6}} \quad (25)$$

$$\frac{M_w}{m_p} \cong \frac{G_s^{1/2} G_e^{1/6} G_N^{1/12}}{G_w^{3/4}} \quad (26)$$

$$\frac{m_p}{m_e} \cong \frac{G_w^{13/4} G_e^{3/2}}{G_s^{9/2} G_N^{1/4}} \quad (27)$$

Based on these relations,

$$G_N \cong \left(\frac{m_e}{m_p}\right)^4 \frac{G_w^{13} G_e^6}{G_s^{18}} \quad (28)$$

Based on the nuclear experiments and astrophysical observations,

1) (G_e) can be estimated from relation (23).
2) (G_s) can be estimated from relations (8-10).
3) (G_w) can be estimated from relation (1).

12. Understanding neutron life time with (G_e, G_w)

One of the key objectives of any unified description is to simplify or eliminate the complicated issues of known physics. Neutron life estimation is one of such complicated issue [29,50,51]. In this context, in our earlier publications [20,52], we proposed the following relations.

$$\left.\begin{aligned} t_n &\cong \left(\frac{G_e}{G_w}\right)\left(\frac{G_e m_n^2}{(m_n - m_p)c^3}\right) \\ &\cong \left(\frac{G_e^2 m_n^2}{G_w (m_n - m_p)c^3}\right) \cong 874.94 \text{ sec} \end{aligned}\right\} \quad (29)$$

Plausible point to be noted is that, relativistic mass of neutron seems to play a crucial role in understanding the increasing neutron life time. It can be understood with,

$$t_n \propto \frac{m_n^2}{\left[1-\left(v^2/c^2\right)\right]} \text{ and } t_n \cong \frac{874.94 \text{ sec}}{\left[1-\left(v^2/c^2\right)\right]} \quad (30)$$

In this way, bottle method [50] and beam method [51] of neutron life time experiments can be correlated with confined and moving neutrons.

13. Discussion

We appeal that,

(1) Success of any unified model depends on its ability to involve gravity in microscopic models.
(2) Full-fledged implementation of gravity in microscopic physics must be able to:
   a) Estimate the ground state elementary particle rest masses of the three atomic interactions.
   b) Estimate the coupling constants of the three atomic interactions.
   c) Estimate the range of all interactions.
   d) Estimate the Newtonian gravitational constant.
(3) As the root/path is unclear and unknown, to make it success or to have a full-fledged implementation, one may be forced to consider a new path that may be out-of-scope of the currently believed string theory models[53].
(4) In our approach,
   a) We assign a different gravitational constant for each basic interaction.
   b) Considering 585 GeV fermion as the characteristic building block of all elementary particles, an attempt is made to fit proton and electron masses.
   c) During this journey, without considering arbitrary numbers or coefficients, we come across many strange and interesting relations for estimating other atomic and nuclear coupling constants.
   d) Based on relations (5) and (6), magnitudes of (G_w, α_s) can be estimated in a verifiable approach.

14. Conclusion

With further study, research and confirming the existence of $M_w c^2 \cong 584.725$ GeV, actual essence of final unification can be understood.

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