Exploration

Applications of Gravitational Model of Possible Final Unification in both Large & Small Scale Physics

U. V. S. Seshavatharam[1,2*] & S. Lakshminarayana[3]

[1]ORNNOVA Technologies India Pvt. Ltd, Bangalore-27, India
[2]Honorary Faculty, I-SERVE, Alakapuri, Hyderabad-35, Telangana, India
[3]Department of Nuclear Physics, Andhra University, Visakhapatnam-03, AP, India

Abstract

Considering two pseudo gravitational constants assumed to be connected with proton and electron, we make an attempt to fit the Newtonian gravitational constant. In this semi- empirical approach, proton-electron mass ratio, reduced Planck's constant and root-mean-square radius of proton seem to play a crucial role. In this approach, a change in 18th decimal place of the root mean square radius of proton seems to change the 14th decimal place of the Newtonian gravitational constant. It may be noted that, with reference to the operating force magnitudes, protons and electrons cannot be considered as 'black holes'. But electrons and protons can be assumed to follow the relations that black holes generally believed to follow where the proposed pseudo gravitational constants take the role of the Newtonian gravitational constant. Proceeding further, by combining the views of S.W. Hawking and Abhas Mithra, melting temperatures of proton, electron and quark soup can be estimated. The two characteristic supporting points to be noted are: 1) Neutron star's mass limit can be understood very easily with the square root of the ratio of gravitational constant associated with proton and the Newtonian gravitational constant; and 2) Square root of the ratio of gravitational constant associated with electron and the Newtonian gravitational constant is matching with Avogadro number by 99%.

Keywords: Gravitational constants, proton radius, reduced Planck's constant, Avogadro number, strong coupling constant, Schwarzschild interaction strength, elementary particle melting points, neutron star.

1. Introduction

According to Roberto Onofrio [1,2], weak interactions are peculiar manifestations of quantum gravity at the Fermi scale, and that the Fermi coupling constant is related to the Newtonian constant of gravitation. In his opinion, at atto-meter scale, Newtonian gravitational constant seems to reach a magnitude of $8.205\times10^{22}\text{m}^3\text{kg}^{-1}\text{sec}^{-2}$. In this context, one can see plenty of papers on 'strong gravity' in physics literature [3-19]. It may be noted that, to date, 'strong gravity' is a non-mainstream theoretical approach to color confinement/particle confinement having both a cosmological scale and particle scale gravity. During 1960 to 2000, it was taken up as an

*Correspondence: Honorary faculty, I-SERVE,Alakapuri,Hyderabad-35,Telangana, India.
E-mail: seshavatharam.uvs@gmail.com

alternative to the then young QCD theory by several theorists, including Abdus Salam [3]. It is very interesting to note that, Abdus Salam showed that the 'particle level gravity approach' can produce confinement and asymptotic freedom while not requiring a force behavior differing from an inverse-square law, as does QCD.

Qualitatively and quantitatively, references [1-20] strongly suggest the possible existence of Newtonian-like gravitational constant with very large magnitude in nuclear and particle physics. Based on this concept and in pursuit of bridging the gap in between General Theory of Relativity and Quantum Field Theory, in the recent publications[21-25], we suggested the existence of two pseudo gravitational constants associated with strong and electromagnetic interactions. It may be noted that, even though 'string theory' and 'quantum gravity' models [26,27] are having a strong mathematical back ground and sound physical basis, both the models are failing in developing a workable model of final unification.

2. Two Assumptions

Assumption1: Magnitude of the gravitational constant associated with electron is:

$$G_e \approx 2.375\times10^{37}\ \text{m}^3\text{kg}^{-1}\text{sec}^{-2}$$

Assumption 2: Magnitude of the gravitational constant associated with proton is:

$$G_s \approx 3.328\times10^{28}\ \text{m}^3\text{kg}^{-1}\text{sec}^{-2}.$$

It may be noted that, with reference to the operating force magnitudes, protons and electrons cannot be considered as 'black holes'. But electrons and protons can be assumed to follow the relations that black holes generally believed to follow. That is, in the study of black holes, Newtonian gravitational constant G_N plays a major role, whereas in the study of elementary particles, G_s and G_e play similar major roles. See Section 8 for detailed information.

3. Key applications of proposed pseudo G_s and G_e in nuclear and atomic structures

By considering the following five important semi-empirical results, one may understand and validate the role of the above proposed two assumptions.

1) Ratio of rest mass of proton and electron:

$$\left(\frac{m_p}{m_e}\right) \cong \left(\frac{G_s m_p^2}{\hbar c}\right)\left(\frac{G_e m_e^2}{\hbar c}\right) \tag{1}$$

2) Nuclear charge radius:

$$R_0 \cong \frac{2G_s m_p}{c^2} \tag{2}$$

3) Root mean square radius of proton:

$$R_p \cong \frac{\sqrt{2}G_s m_p}{c^2} \tag{3}$$

4) Bohr radius of electron in hydrogen atom:

$$a_0 \cong \left(\frac{4\pi\varepsilon_0 G_e m_e^2}{e^2}\right)\left(\frac{G_s m_p}{c^2}\right) \tag{4}$$

5) Ground state total energy of electron in hydrogen atom:

$$\left(E_{total}\right)_{ground} \cong -\left(\frac{e^2}{4\pi\varepsilon_0 G_e m_e^2}\right)\left(\frac{e^2}{4\pi\varepsilon_0 R_0}\right) \tag{5}$$

where, $R_0 \approx 1.24$ fm.

3. Fitting the Newtonian gravitational constant

It may be noted that, coupling Newtonian gravitational constant G_N with elementary physical constants is really a challenging issue and demands sound physical reasoning. It may also be noted that, as gravity is much weaker than other fundamental forces and an experimental apparatus cannot be separated from the gravitational influence of other bodies, G_N is quite difficult to measure [28-35]. So far, no standard model could couple gravity with other fundamental forces and hence with current unified models, it does not appear possible to calculate the value of G_N directly from other accurately known microscopic physical constants. In this context, with reference to the proposed assumptions and if, $M_{pl} \cong \sqrt{\hbar c/G_N} \cong \text{Planck mass}$, we discovered that:

$$\left(\frac{m_p}{m_e}\right) \cong \left(\frac{G_N}{G_e}\right)^{\frac{1}{3}}\left(\frac{M_{pl}}{m_p}\right) \tag{6}$$

On simplification,

$$G_e \cong \frac{\hbar^2 c^2}{G_s m_p m_e^3} \cong \left(\frac{\hbar c}{G_s m_p m_e}\right)\left(\frac{\hbar c}{m_e^2}\right) \tag{7}$$

$$G_N \cong \left(\frac{\hbar^3 c^3 m_e^6}{G_e^2 m_p^{12}}\right) \cong \left(\frac{G_s m_p^2}{\hbar c}\right)\left(\frac{m_e}{m_p}\right)^{12} G_s \tag{8}$$

4. Characteristic relation for fixing the Newtonian gravitational constant

From above relation (6), Newtonian gravitational constant can be expressed in the following way.

$$G_N \cong \left(\frac{m_e}{m_p}\right)^{12}\left(\frac{c^3 R_p^2}{2\hbar}\right) \cong 8.698623312\times 10^{19} R_p^2 \tag{9}$$

where R_p is the root mean square radius of proton [28,29,36,37]. For example,

Case − 1:	Case − 2:
If, $\underline{R_p \cong 0.87(58)\times 10^{-15}\ \text{m}}$,	If, $\underline{R_p \cong 0.87(60)\times 10^{-15}\ \text{m}}$,
$G_s \cong 3.327619051\times 10^{28}\ \text{m}^3\text{kg}^{-1}\text{sec}^{-2}$	$G_s \cong 3.328378955\times 10^{28}\ \text{m}^3\text{kg}^{-1}\text{sec}^{-2}$
$G_e \cong 2.375720961\times 10^{37}\ \text{m}^3\text{kg}^{-1}\text{sec}^{-2}$	$G_e \cong 2.375178559\times 10^{37}\ \text{m}^3\text{kg}^{-1}\text{sec}^{-2}$
$\underline{G_N \cong 6.67(2067113)\times 10^{-11}\ \text{m}^3\text{kg}^{-1}\text{sec}^{-2}}$	$\underline{G_N \cong 6.67(5114762)\times 10^{-11}\ \text{m}^3\text{kg}^{-1}\text{sec}^{-2}}$

This estimated range of G_N can be compared with the most recent (CODATA: 2014) recommended value of $G_N \cong 6.67408(31)\times 10^{-11}\ \text{m}^3\text{kg}^{-1}\text{sec}^{-2}$. In this proposed method, a change in 18$^{\text{th}}$ decimal place of the root mean square radius of proton seems to change the 14$^{\text{th}}$ decimal place of the Newtonian gravitational constant. Thus, by fixing the root mean square radius of proton, magnitude of the gravitational constant can be fixed to some extent. Interesting observation is that:

$$\sqrt{\frac{G_e}{G_N}} \approx 5.96\times 10^{23} \tag{10}$$

This number is very close to the Avogadro number [28,29]. In this context, we published interesting contributions in Indian DAE-BRNS conference proceedings and proceedings of International Intradisciplinary Conference on the Frontiers of Crystallography [22-25].

5. Applications of G_s in elementary particle physics

If one is willing to consider G_s as a real fundamental quantity connected with nuclear and atomic structure, it is possible to have the following major applications.

A) The reduced Planck's constant, $\hbar$

$$\hbar \cong \left\{\left(\frac{m_e}{m_p}\right)^{12}\left(\frac{G_s}{G_N}\right)\right\}\left(\frac{G_s m_p^2}{c}\right) \tag{11}$$

B) The strong coupling constant, α_s

$$\alpha_s \cong \left(\frac{\hbar c}{G_s m_p^2}\right)^2 \cong \left\{\left(\frac{m_e}{m_p}\right)^{24}\left(\frac{G_s}{G_N}\right)^2\right\} \approx 0.1153 \tag{12}$$

Note 1: It may be noted that $\exp(0.1153)-1 \cong 0.1222$.

Note 2: If it is possible to guess that 0.1153 and 0.1222 as the lower and upper limits of α_s respectively, average value of 0.1153 and 0.1222 is 0.11875 and is very close to the recommended world average value of 0.1185 ± 0.0006 [28,29].

Here in these two relations, appearance of $\left\{\left(\frac{m_e}{m_p}\right)^{12}\left(\frac{G_s}{G_N}\right)\right\}$ seems to be odd and very complicated to understand. It can be simplified in the following section.

6. Physical significance and applications of $\sqrt{\alpha_s}$

If e_e is the currently believed electromagnetic charge, it is possible to guess that, in nuclear and sub nuclear physics, there exists a new elementary charge, e_s in such a way that,

$$\begin{aligned} \frac{e_e}{e_s} &\cong \left\{\left(\frac{m_e}{m_p}\right)^{12}\left(\frac{G_s}{G_N}\right)\right\} \cong \left(\frac{\hbar c}{G_s m_p^2}\right) \cong \sqrt{\alpha_s} \\ \Rightarrow e_s &\cong \frac{e_e}{\sqrt{\alpha_s}} \approx 4.72\times 10^{-19} \text{ C} \end{aligned} \tag{13}$$

Thus, the compound and complicated product $\left\{\left(\frac{m_e}{m_p}\right)^{12}\left(\frac{G_s}{G_N}\right)\right\}$ transforms into a simple physical "charge ratio". Like invisible quarks, this new e_s'that is physically undetectable' can be called as the 'invisible nuclear elementary charge'. Important point to be noted is that, it always seems to be associated with proton. Clearly speaking, For the case of proton, its characteristic primary charge is e_s rather than e_e. It is having many direct and indirect applications in nuclear and atomic structure. See the following applications.

I) Proton-electron mass ratio,

$$\frac{m_p}{m_e} \cong \left(\frac{e_e^2}{4\pi\varepsilon_0 G_e m_e^2}\right) \Big/ \left(\frac{e_s^2}{4\pi\varepsilon_0 G_s m_p^2}\right) \cong \left(\frac{e_e^2 G_s}{e_s^2 G_e}\right)^{\frac{1}{3}} \tag{14}$$

II) Square root of force ratio,

$$\sqrt{\frac{e_s^2}{4\pi\varepsilon_0 G_s m_p m_e}} \cong 2\pi \tag{15}$$

III) Fine structure constant,

$$\alpha \cong \left(\frac{e_e e_s}{4\pi\varepsilon_0 G_s m_p^2}\right) \tag{16}$$

IV) Magnetic moment of proton,

$$\mu_p \cong \frac{e_s \hbar}{2m_p} \cong \frac{G_s m_p e_e}{2c} \tag{17}$$

V) Magnetic moment of neutron,

$$\mu_n \cong \frac{e_s \hbar}{2m_n} - \frac{e_e \hbar}{2m_n} \cong \frac{\hbar}{2m_n}\left(e_s - e_e\right) \tag{18}$$

VI) Specific charge ratio of proton-electron,

$$\left(\frac{e_s}{m_p}\right) \Big/ \left(\frac{e_e}{m_e}\right) \cong \left(\frac{G_s m_p m_e}{\hbar c}\right) \cong \left(\frac{\hbar c}{G_e m_e^2}\right) \tag{19}$$

VII) Reduced Planck's constant,

$$\hbar \cong \left(\frac{e_e}{e_s}\right)\left(\frac{G_s m_p^2}{c}\right) \cong \sqrt{\frac{m_e}{m_p}} \sqrt{\left(\frac{G_s m_p^2}{c}\right)\left(\frac{G_e m_e^2}{c}\right)} \tag{20}$$

VIII) Fermi's weak coupling constant:

$$F_W \cong \left[\frac{m_e^2}{m_p^2}\right]\left(\hbar c R_0^2\right) \cong \left(\frac{e_e}{e_s}\right) \frac{\left(G_s m_p^2\right)\left(G_s m_e^2\right)}{\left(c^4 / 4G_s\right)} \tag{21}$$

IX) Proton's characteristic nuclear potential:

$$E_{proton} \cong -\frac{e_s^2}{4\pi\varepsilon_0 \left(G_s m_p / c^2\right)} \approx -20.0 \text{ MeV} \tag{22}$$

X) Nuclear binding energy at stability zone of $(Z \geq 30)$:

$$B \approx -\frac{(Z-1)e_s^2}{4\pi\varepsilon_0\left(G_s m_p / c^2\right)} \approx -(Z-1)\times 20.0 \text{ MeV} \tag{23}$$

where, Stable mass number, $A_s \cong 2Z + \left\{\left(\frac{e_s}{m_p}\right) \Big/ \left(\frac{e_e}{m_e}\right)\right\}(2Z)^2 \approx Z(2+0.00642Z)$

XI) Nuclear binding energy at stability zone of $Z \approx (3 \text{ to } 29)$:

$$B \approx -\left(\frac{Z-1}{30}\right)^{\frac{1}{12}} \frac{(Z-1)e_s^2}{4\pi\varepsilon_0\left(G_s m_p / c^2\right)} \approx -\left(\frac{Z-1}{30}\right)^{\frac{1}{12}} (Z-1)\times 20.0 \text{ MeV} \tag{24}$$

where, Stable mass number, $A_s \cong 2Z + \left\{\left(\frac{e_s}{m_p}\right) \Big/ \left(\frac{e_e}{m_e}\right)\right\}(2Z)^2 \approx Z(2+0.00642Z)$

7. Applications of G_e in elementary particle physics and astrophysics

7.1 Understanding the recently observed 3.5 keV galactic photon

Recent galactic X-ray [38-42] studies strongly confirm the existence of a new photon of energy 3.5 keV. Its origin is unknown and scientists guess that, it is a decay product of 7 keV sterile neutrino. In this context, we would like to suggest the following alternative mechanism for understanding the origin of 3.5 keV photon.

A) There exists a charged lepton of rest mass,

$$(m_{xl})^{\pm} \approx \sqrt{\frac{e_e^2}{4\pi\varepsilon_0 G_e}} \approx 1.75 \text{ keV}/c^2 \tag{25}$$

B) $(m_{xl}) \approx 1.75 \text{ keV}/c^2$ plays a vital role generating the observed charged leptons.
C) With pair annihilation mechanism, (m_{xl}) generates a photon of rest energy 3.5keV
D) With current and future particle accelerators $(m_{xl})^{\pm} \approx 1.75 \text{ keV}/c^2$ can be generated.

Note: Similar to $\sqrt{\frac{e_e^2}{4\pi\varepsilon_0 G_e}} \cong 1.75 \text{ keV}/c^2$, for strong interaction, it is possible to construct a characteristic fermion of rest mass, $\sqrt{\frac{e_s^2}{4\pi\varepsilon_0 G_s}} \cong 137.2 \text{ MeV}/c^2$ or $\sqrt{\frac{\hbar c}{G_s}} \cong 546.75 \text{ MeV}/c^2$ can be considered as the basic building block of hadrons. Considering $\left(\frac{e_s}{e_e}\right)^{\frac{1}{4}}\sqrt{\frac{\hbar c^5}{G_s}} \cong 938.3\text{ MeV}$, as a characteristic mass unit, it is possible to show that, excited energy levels of baryons are proportional to $\left\{\left[n(n+1)\right]^{\frac{1}{4}} \text{ or } n^{\frac{1}{4}}\right\}$ where $n = 1, 2, 3, ...$. This concept seems to be in-line with 'string theory'. We are working in this direction.

7.2 Fitting muon and tau rest masses

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

$$m_{(\mu,\tau)}c^2 \cong \left[\gamma^3 + \left(n^2\gamma\right)^n \sqrt[4]{\frac{G_e}{G_N}}\right]^{\frac{1}{3}} 1.75\text{ keV}$$
$$\text{where, } \gamma \approx \sqrt{\frac{4\pi\varepsilon_0 G_e m_e^2}{e^2}} \approx 292.3 \text{ and } n = 1 \text{ and } 2. \qquad (26)$$

For $n=1$, obtained $m_\mu c^2 \approx 106\text{ MeV}$ and $n=2$, obtained $m_\tau c^2 \approx 1770\text{ MeV}$

8. Proposed basic concepts of final unification

Important points to be noted are:

1) If it is true that c and G_N are fundamental physical constants, then $\left(c^4/G_N\right)$ can be considered as a fundamental compound constant related to a characteristic limiting force [43-46].
2) Black holes are the ultimate state of matter's geometric structure.
3) Magnitude of the operating force at the black hole surface is of the order of $\left(c^4/G_N\right)$.
4) Gravitational interaction taking place at black holes can be called as 'Schwarzschild interaction'.
5) Strength of 'Schwarzschild interaction' can be assumed to be unity.
6) Strength of any other interaction can be defined as the ratio of operating force magnitude and the classical or astrophysical force magnitude $\left(c^4/G_N\right)$.
7) If one is willing to represent the magnitude of the operating force as a fraction of $\left(c^4/G_N\right)$ i.e. X times of $\left(c^4/G_N\right)$, where $X \ll 1$, then

$$\frac{X \text{ times of } \left(c^4/G_N\right)}{\left(c^4/G_N\right)} \cong X \to \text{Effective } G \Rightarrow \frac{G_N}{X} \quad (27)$$

If X is very small, $(1/X)$ becomes very large. In this way, X can be called as the strength of interaction. That is, strength of any interaction is $\frac{1}{X}$ times less than the 'Schwarzschild interaction' and effective G becomes (G_N/X).

8) With reference to Schwarzschild interaction, for electromagnetic interaction, $X \approx 2.811\times10^{-48}$ and for strong interaction, $X \cong 2.0\times10^{-39}$.
9) Characteristic operating force corresponding to electromagnetic interaction is $\left(c^4/G_e\right) \approx 3.4\times10^{-4}$ N and characteristic operating force corresponding to strong interaction is $\left(c^4/G_s\right) \approx 242600$ N.
10) Characteristic operating power corresponding to electromagnetic interaction is $\left(c^5/G_e\right) \approx 10990$ J/sec and characteristic operating power corresponding to strong interaction is $\left(c^5/G_s\right) \approx 7.27\times10^{13}$ J/sec
11) Based on these concepts, it is possible to assume that,

$$\hbar c \cong \frac{\left(m_e c^2\right)^{\frac{3}{2}}\left(m_p c^2\right)^{\frac{1}{2}}}{\sqrt{\left(c^4/G_e\right)\left(c^4/G_s\right)}} \quad (28)$$

$$\hbar \cong \frac{\left(m_e c^2\right)^{\frac{3}{2}}\left(m_p c^2\right)^{\frac{1}{2}}}{\sqrt{\left(c^5/G_e\right)\left(c^5/G_s\right)}} \quad (29)$$

12) As $\left[\left(c^4/G_e\right),\left(c^4/G_s\right)\right] \ll \left(c^4/G_N\right)$ and $\left[\left(c^5/G_e\right),\left(c^5/G_s\right)\right] \ll \left(c^5/G_N\right)$, protons and electrons can not be considered as 'black holes', but may be assumed to follow similar relations that black holes generally believed to follow.

9. Melting temperatures of elementary particles

According to S.W. Hawking [47], temperature of black hole takes the following expression.

$$T_B \cong \frac{\hbar c^3}{8\pi G_N k_B M_B} \quad (30)$$

where M_B and T_B represent the mass and temperature of a black hole respectively.

According to Abhas Mithra [48,49], currently believed 'black holes' are a kind of "Eternally

Collapsing Objects". The so-called massive Black Hole Candidates (BHCs) must be quasi-black holes rather than exact black holes and during preceding gravitational collapse, entire mass energy and angular momentum of the collapsing objects must be radiated away before formation of exact mathematical black holes. Abhas Mitra's peer reviewed papers describe why continued physical gravitational collapse should lead to formation of ECOs rather than true black holes, and the mathematical "black hole" states can be achieved only asymptotically. An ECO is essentially a quasi-stable ultra-compact ball of fire (plasma) which is so hot due to preceding gravitational contraction that its outward radiation pressure balances its inward pull of gravity. Some astrophysicists claimed to have verified this prediction that astrophysical Black Hole Candidates are actually ECOs rather than true mathematical black holes. One can find relevant information at http://www.cv.nrao.edu/tuna/past/2006/NEW_QSO_STRUCTURE_FOUND.pdf

By considering these two views and by considering the proposed views, melting temperature of elementary particles can be estimated very easily.

1) Proton melting temperature

$$T_p \cong \frac{\hbar c^3}{8\pi k_B G_s m_p} \approx 1.47\times10^{11}\text{ K} \approx 0.147\text{ Trillion K} \tag{31}$$

This prediction is for experimental verification.

2) Electron melting temperature

$$T_e \cong \frac{\hbar c^3}{8\pi k_B G_e m_e} \approx 5.67\times10^{15}\text{ K} \approx 5670\text{ Trillion K} \tag{32}$$

It may be noted that, as electron is a weakly interacting particle, its melting temperature seems to be 38580 times higher than melting temperature of proton.

3) Melting temperatures of quarks

Proceeding further, quark gluon plasma temperature can be estimated very easily [50-54]. From PDG data, up quark mass is 2.15 MeV/c^2, down quark mass is 4.7 MeV/c^2 and strange quark mass is 93.5 MeV/c^2. Similarly, charm quark mass is 1275 MeV/c^2, bottom quark mass is 4180 MeV/c^2 and top quark mass is 173210 MeV/c^2.Based on this data,

A) Melting temperature of up quark

$$T_{up} \cong \frac{\hbar c^3}{8\pi k_B G_s m_{up}} \approx 6.42\times10^{13}\text{ K} \approx 64\text{ Trillion K} \tag{33}$$

B) Melting temperature of down quark

$$T_{down} \cong \frac{\hbar c^3}{8\pi k_B G_s m_{down}} \approx 2.93\times 10^{13} \text{ K} \approx 29 \text{ Trillion K} \quad (34)$$

C) Melting temperature of strange quark

$$T_{strange} \cong \frac{\hbar c^3}{8\pi k_B G_s m_{strange}} \approx 1.47\times 10^{12} \text{ K} \approx 1.47 \text{ Trillion K} \quad (35)$$

D) **Melting temperature of charm quark**

$$T_{charm} \cong \frac{\hbar c^3}{8\pi k_B G_s m_{charm}} \approx 1.08\times 10^{11} \text{ K} \approx 0.11 \text{ Trillion K} \quad (36)$$

E) **Melting temperature of bottom quark**

$$T_{bottom} \cong \frac{\hbar c^3}{8\pi k_B G_s m_{bottom}} \approx 3.3\times 10^{11} \text{ K} \approx 0.33 \text{ Trillion K} \quad (37)$$

F) **Melting temperature of top quark**

$$T_{top} \cong \frac{\hbar c^3}{8\pi k_B G_s m_{top}} \approx 0.8\times 10^{9} \text{ K} \approx 0.8 \text{ Billion K} \quad (38)$$

It may be noted that, RHIC have tentatively claimed to have created a quark–gluon plasma with an approximate temperature of **4 trillion degree Kelvin**. A new record breaking temperature was set by ALICE at CERN on August, 2012 in the ranges of **5.5 trillion degree Kelvin.** In June 2015, an international team of physicists have produced quark-gluon plasma at the Large Hadron Collider by colliding protons with lead nuclei at high energy inside the supercollider's Compact Muon Solenoid detector at a temperature of **4 trillion degree Kelvin** [50]. These experimental temperatures are close to the predicted melting temperatures of Proton, up, down and strange quarks and seem to support the proposed pseudo gravitational constant assumed to be associated with proton.

10.Fitting & understanding the mass limit &radius of neutron star

Currently believed neutron star mass limit is ~3.2 solar masses[55-59].If (M_n, m_n) represent the mass limit of neutron star and neutron mass respectively, it is noticed that,

$$\left(\frac{G_N M_n m_n}{\hbar c}\right) \cong \sqrt{\frac{G_s}{G_N}}$$
$$\Rightarrow M_n \cong \left(\frac{G_s}{G_N}\right)^{1/2}\left(\frac{\hbar c}{G_N m_n}\right) \cong 6.32\times10^{30}\ \text{kg} \tag{39}$$

$$\frac{M_n}{m_n} \cong \left(\frac{e_e}{e_s}\right)\left(\frac{G_s}{G_N}\right)^{3/2} \cong 3.18M_{\odot} \tag{40}$$

Neutron star radius R_n can be fitted with the following expression.

$$R_n \approx \sqrt{\frac{G_s}{G_N}}\left(\frac{G_s m_p}{c^2}\right) \approx 13.5\ \text{km} \tag{41}$$

It may be noted that, mass distribution point of view, white dwarf stars' characteristic mass is peaked at [60], $(M_{wd})_{peak} \approx (0.6)\mathrm{M}_{\odot}$. Based on this observation, it is noticed that,

$$\frac{M_n}{(M_{wd})_{peak}} \cong \frac{e_e^2}{4\pi\varepsilon_0 G_s m_p m_e} \cong 4.54 \tag{42}$$

With reference to the Chandrasekhar mass limit, $M_C \approx (1.4 \text{ to } 1.5)\mathrm{M}_{\odot}$, it is noticed that,

$$\frac{M_n}{M_C} \cong \left(\frac{e_e^2}{4\pi\varepsilon_0 G_s m_p m_e}\right)^{\frac{1}{2}} \cong 2.13 \tag{43}$$

Thus, the characteristic white dwarf peak mass limit, Chandrasekhar mass limit and neutron star mass limit can be inter-related in the following way.

$$M_C \cong \sqrt{M_n (M_{wd})_{peak}} \tag{44}$$

Proceeding further, the characteristic white dwarf mass limits of $(0.6)\mathrm{M}_{\odot}$ and $1M_{\odot}$ and Chandrasekhar mass limit can be inter-related in the following way.

$$(M_{wd})_{\odot} \approx \sqrt{(M_{wd})_{peak} \times M_C} \tag{45}$$

11.Discussion

Relations (1-43) clearly demonstrate the role of proposed pseudo gravitational constants assumed to be associated with proton and electron. At first sight, their physical existence appears to be ad-hoc and numerological, but by seeing the applications one may be forced to think that, there is 'some new physics' behind their assumed 'pseudo presence'. In short, we find:

1) Relations (1 to 5) clearly address the nuclear and atomic structures.
2) Relations (6 to 9) clearly address the Newtonian gravitational constant.
3) Relation (10) seems to address the Avogadro number in a qualitative approach.
4) Proton-Electron mass ratio can be addressed with relations (1), (6) and (14) in three different unified methods.
5) Relation (12) clearly addresses the way of estimating the magnitude of the currently believed strong coupling constant.
6) Relation (13) seems to address the existence of a new elementary invisible nuclear elementary charge.
7) Relations (11), (20) and (29) seem to address the origin of reduced Planck's constant in three different unified methods.
8) Relation (16) seems to address the way of understanding the origin of Fine structure ratio in a unified method that is independent of the reduced Planck's constant.
9) Relations (17) and (18) seem to address the origin of magnetic moments of proton and neutron at fundamental level.
10) Relation (19) seems to throw light on the proton-electron specific charge ratio in a very peculiar way.
11) Relation (21) seems to address the mystery of the famous Fermi's weak coupling constant.
12) Relations (22,23 and 24) seem to address the mystery of origin of nuclear binding energy in a very simplified approach.
13) Relation (25) seems to address the possible existence of a new charged lepton that can be considered as the mother of recently observed 3.5 keV photon confirmed to be associated with galactic X-ray study.
14) Relations (25 and 26) seem to address the mystery of origin of the rest masses of muon and tau.
15) Relation (27) seems to address the strength of interactions with respect to the Schwarzschild interaction strength.
16) Relations (30 to 38) seem to address the unified mechanism of melting points of elementary particles.
17) Relations (39 and 43) clearly address the combined role of gravitational constant associated with proton and the Newtonian gravitational constant in understanding the neutron star mass limit and radius.
18) Relations (42 to 45) roughly address the inter-relation that might be existing in between white dwarf star masses, Chandrasekhar mass limit and neutron star mass limit.

We stress the fact that, with currently believed unified (main stream) physics models it is impossible to discover/fit/derive such relations. If one is willing to consider this fact as a real inadequacy of current unified physics models, in an unbiased approach, the proposed two pseudo gravitational constants should be considered in an in-depth study at fundamental level. If it is true that, there exist 3 different gravitational constants in nature, then collectively they may throw some light on any one of the characteristic property of either strong interaction or electromagnetic interaction.

Thinking in this way, we discovered the following very strange equation.

$$\ln\left(\frac{G_s^4}{G_e^2 G_N^2}\right) \approx \frac{1}{\alpha} \approx 137.44 \tag{46}$$

Accuracy can be improved if it is assumed that

$$\ln\left[\left(\frac{2}{3}\right)\left(\frac{G_s^4}{G_e^2 G_N^2}\right)\right] \cong \frac{1}{\alpha} \tag{47}$$

Another interesting and accurate relation connected with strong coupling constant can be expressed as follows:

$$\frac{G_s}{G_N^{1/6} G_e^{5/6}} \cong \alpha_s \cong 0.1180 \tag{48}$$

This can be compared with the lower limit of world average value of the strong coupling constant 0.1185 ± 0.0006.

12.Conclusion

By considering the proposed concepts and relations, we would like to highlight the following points:

A) With further research, in near future, relation like (8) can be developed and absolute value of the Newtonian gravitational constant can be estimated with atomic and nuclear physical constants.
B) The proposed two assumptions can be given some priority at fundamental level and with further research, their state of ‘physical existence’ (whether pseudo or real) can be assessed.
C) If one is willing to explore the possibility of incorporating the proposed assumptions either in ‘string theory’ models or in ‘quantum gravity’ models or ‘strong gravity’ models, certainly, back ground physics assumed to be connected with proposed semi-empirical relations can be understood and a practical model of everything may be developed.

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