Understanding the basics of final unification with three gravitational constants associated with nuclear, electromagnetic and gravitational interactions

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Introduction

Based on the old and ignored scientific assumption put forward by Nobel laureate Abdus Salam [1], we propose two large pseudo gravitational constants assumed to be associated with strong and electromagnetic interactions [2]. With them, currently believed generalized physical constants like, proton-electron mass ratio, neutron life time, weak coupling constant, strong coupling constant, nuclear charge radius, root mean square radius of proton, Planck's constant, Bohr radius of hydrogen atom, molar mass constant, Avogadro number and Newtonian gravitational constant etc and concepts like nuclear binding energy, nuclear stability, nuclear charge radii and atomic radii. can be reviewed in a unified approach. In addition, neutron star mass and radius can be understood with the ratio of nuclear and Newtonian gravitational constants.

Two basic assumptions of final unification

Assumption-1: Magnitude of the gravitational constant associated with the electromagnetic interaction is,
$G_e \cong (2.375 \pm 0.002)\times 10^{37}\ \text{m}^3\text{kg}^{-1}\text{sec}^{-2}$.

Assumption-2: Magnitude of the gravitational constant associated with the strong interaction is,
$G_s \cong (3.328 \pm 0.002)\times 10^{28}\ \text{m}^3\text{kg}^{-1}\text{sec}^{-2}$.

Note: We chose (G_e, G_s) in such a way that,

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

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

Relation between m_p and m_e

Based on the Planck mass, $M_{pl} \cong \sqrt{\hbar c/G_N}$

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

If nuclear Planck mass is defined as,
$m_{npl} \cong \sqrt{\hbar c/G_s} \approx 546.7\ \text{MeV}/c^2$,

$$m_e \cong \left(\frac{m_p^5 m_{npl}^2}{M_{pl}}\right)^{1/6} \cong \left(\left(\frac{G_N}{G_s}\right) m_{npl}^2 m_p^{10}\right)^{1/12} \tag{4}$$

$$m_p \cong \left(\frac{m_e^6 M_{pl}}{m_{npl}^2}\right)^{1/5} \cong \left(\left(\frac{G_s}{G_N}\right)\frac{m_e^{12}}{m_{npl}^2}\right)^{1/10} \tag{5}$$

$$\hbar \cong \left(\frac{G_s}{G_N}\right)\left(\frac{m_e}{m_p}\right)^{10}\left(\frac{G_s m_e^2}{c}\right) \tag{6}$$

To fix the magnitudes of G_s, G_e and G_N

It is possible to obtain the following relation.

$$h \cong \sqrt{\frac{m_p}{m_e}}\sqrt{\left(\frac{G_s m_p^2}{c}\right)\left(\frac{e^2}{4\pi\varepsilon_0 c}\right)} \tag{7}$$

Based on this relation [3],

$$G_s \cong \frac{4\pi\varepsilon_0 h^2 c^2 m_e}{e^2 m_p^3} \cong 3.329560807\times 10^{28}\ \frac{\text{m}^3}{\text{kg.sec}^2} \tag{8}$$

$$G_e \cong \left(\frac{e^2 m_p^2}{16\pi^3 \varepsilon_0 m_e^4}\right) \cong 2.374335471\times 10^{37}\ \frac{\text{m}^3}{\text{kg.sec}^2} \tag{9}$$

$$G_N \cong \left(\frac{m_e}{m_p}\right)^{14}\left(\frac{4\pi\varepsilon_0}{e^2}\right)^2\left(\frac{2\pi h^3 c^3}{m_p^2}\right) \tag{10}$$

$\cong 6.679856051\times 10^{-11}\ \text{m}^3\text{kg}^{-1}\text{sec}^{-2}$

To fit neutron life time and strong coupling constant

Let, t_n be the life time of neutron. Quantitatively it is possible to show that [3],

$$\frac{(m_n - m_p)}{m_n} \cong \sqrt{\frac{G_e}{G_N}}\left(\frac{G_s m_n}{c^3 t_n}\right) \quad (11)$$

where $\sqrt{\frac{G_e}{G_N}} \cong 5.96\times10^{23} \approx$ Avogadro number.

$$t_n \cong \sqrt{\frac{G_e}{G_N}}\left(\frac{G_s m_n^2}{(m_n - m_p)c^3}\right) \approx 896 \text{ sec} \quad (12)$$

With reference to the Weak coupling constant G_F and the proposed G_s,

$$G_N \cong \left(\frac{m_e}{m_p}\right)^{7/2} \frac{\sqrt{G_s G_F}}{2t_n (m_n - m_p)c} \quad (13)$$

If one is willing to define the strong coupling constant [3] as, $\alpha_s \cong \left(\frac{\hbar c}{G_s m_p^2}\right)^2$,

$$t_n \cong \sqrt{\frac{G_e}{G_N}}\sqrt{\frac{1}{\alpha_s}}\left(\frac{\hbar}{(m_n - m_p)c^2}\right) \cong \frac{303.42 \text{ sec}}{\sqrt{\alpha_s}} \quad (14)$$

If, $\alpha_s \cong 0.1185 \pm 0.0006$, $t_n \cong 881.422$ sec .

$$G_N \cong \frac{1}{\alpha_s}\left(\frac{\hbar}{t_n (m_n - m_p)c^2}\right)^2 G_e \cong 6.70\times10^{-11} \frac{\text{m}^3}{\text{kg.sec}^2}$$

where, $\alpha_s \cong 0.1185 \pm 0.0006$, $t_n \cong (880.3 \pm 1.1)$ sec...(15)

To fit the nuclear charge radius and root mean square radius of proton

Nuclear charge radius can be expressed with the following relation.

$$R_0 \cong \frac{2G_s m_p}{c^2} \approx 1.24\times10^{-15} \text{ m} \quad (16)$$

Root mean square radius of proton [3] can be expressed with the following relation.

$$R_p \cong \frac{\sqrt{2}G_s m_p}{c^2} \approx 0.876\times10^{-15} \text{ m} \quad (17)$$

Based on relations (16) and (17),

$$G_N \cong \left(\frac{m_e}{m_p}\right)^{12}\left[\left(\frac{c^3 R_0^2}{4\hbar}\right) \text{Or} \left(\frac{c^3 R_p^2}{2\hbar}\right)\right] \quad (18)$$

To fit Fermi's weak coupling constant and Newtonian gravitational constant

To a great surprise, it is noticed that[3],

$$G_F \cong \left(\frac{m_e}{m_p}\right)^2 \hbar c R_0^2 \quad (19)$$

From above relations,

$$G_F \cong \left(\frac{4G_s^2 m_e^2 \hbar}{c^3}\right) \cong 1.44\times10^{-62} \text{ J.m}^3 \quad (20)$$

$$G_N \cong \left(\frac{m_e}{m_p}\right)^{10}\left(\frac{G_F c^2}{4\hbar^2}\right) \cong 6.66\times10^{-11} \frac{\text{m}^3}{\text{kg.sec}^2} \quad (21)$$

where, $G_F \cong 1.1663787\times10^{-5}(\hbar c)^3$ GeV^{-2}

Mass and radius of neutron star

Let (M_{NS}, R_{NS}) represent mass and radius of neutron star [4] respectively. It is noticed that,

$$\frac{G_N M_{NS} m_n}{\hbar c} \approx \sqrt{\frac{G_s}{G_N}} \quad (22)$$

$$M_{NS} \approx \sqrt{\frac{G_s}{G_N}}\left(\frac{\hbar c}{G_N m_n}\right) \approx 3.17 \text{ Solar mass} \quad (23)$$

$$\frac{R_{NS}}{\left(\sqrt{G_N \hbar / c^3}\right)} \approx \frac{G_s}{G_N} \quad (24)$$

$$R_{NS} \approx \left(\frac{G_s}{G_N}\right)\sqrt{\frac{\hbar G_N}{c^3}} \approx \sqrt{\frac{G_s}{G_N}}\sqrt{\frac{\hbar G_s}{c^3}} \approx 8.1 \text{ km} \quad (25)$$

References

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