Fitting neutron lifetime with 4G model of final unification

U. V. S. Seshavatharam [1,2,*], T. Gunavardhana Naidu[3] and S. Lakshminarayana[4]

[1]*Honorary faculty, I-SERVE, Survey no-42, Hitech city, Hyderabad-84,Telangana, India*
[2]*Quality Assurance Dept, Casting, DIP Division, Electrosteel Castings Ltd, Srikalahasthi, AP, India.*
[3]*Dept. of Physics, Aditya Institute of Technology and Management, Tekkali-03, AP, India*
[4]*Dept. of Nuclear Physics, Andhra University, Visakhapatnam-03, AP, India*

Introduction

With our 4G model of final unification, we make an attempt to understand the mystery of lifetime of neutron. Considering the ratio of neutron-proton mass difference and electron rest mass,

$$t_n \cong \exp\left[\frac{16\pi^2}{\ln(4\pi)}\right]\left(\frac{\hbar}{m_n c^2}\right) \cong 874.2 \text{ sec.}$$

Proceeding further, we show many interesting relations.

Three assumptions of 4G model of final Unification

1) There exists a characteristic electroweak fermion of rest energy, $M_{wf}c^2 \cong 584.725$ GeV . It can be considered as the zygote of all elementary particles.
2) There exists a nuclear elementary charge in such a way that, $\left(\frac{e}{e_n}\right)^2 \cong \alpha_s \cong 0.1151935 =$ Strong coupling constant and $e_n \cong 2.946362e$.
3) Each atomic interaction is associated with a characteristic large gravitational coupling constant. Their fitted magnitudes are,

$$\left.\begin{array}{l} G_e \cong \text{Electromgnetic gravitational constant} \\ \quad \cong 2.374335\times10^{37}\ \text{m}^3\text{kg}^{-1}\text{sec}^{-2} \\ G_n \cong \text{Nuclear gravitational constant} \\ \quad \cong 3.329561\times10^{28}\text{m}^3\ \text{kg}^{-1}\text{sec}^{-2} \\ G_w \cong \text{Electroweak gravitational constant} \\ \quad \cong 2.909745\times10^{22}\ \text{m}^3\text{kg}^{-1}\text{sec}^{-2} \end{array}\right\}$$

Based on these fits,

1) Newtonian gravitational constant can be estimated with a relation of the form,

$$G_N \cong \frac{G_w^{21}G_e^{10}}{G_n^{30}} \cong 6.679851\times10^{-11}\ \text{m}^3\text{kg}^{-1}\text{sec}^{-2}$$

2) Strong coupling constant can be fitted with a relation of the form, $\alpha_s \cong \frac{G_w^6 G_e^4}{G_n^{10}} \cong 0.115193455.$

3)As a pure ratio or number, independent of system of units, Avogadro like large number can be fitted with a relation of the form,

$$\frac{\text{Product of short range gravitational constants}}{\text{Product of long range gravitational constants}}$$

$$\cong \frac{G_n G_w}{G_N G_e} \cong \frac{G_n^{31}}{G_w^{20}G_e^{11}} \cong 6.1088144\times10^{23}.$$

Important ratios

1) Proton-electron mass ratio can be expressed as $\frac{m_p}{m_e} \cong \frac{G_n^3}{G_w^2 G_e}$
2) Strong coupling constant can be expressed as $\alpha_s \cong \left(\frac{e}{e_n}\right)^2 \cong \left(\frac{\hbar c}{G_n m_p^2}\right)^2 \cong \frac{G_e m_e^3}{G_n m_p^3}$
3) Ratio of speific charge ratio of proton and specific charge ratio of electron can be expressed as $\left(\frac{e_n}{m_p}\right)\div\left(\frac{e}{m_e}\right) \cong \frac{e_n m_e}{e m_p} \cong \frac{G_n m_p m_e}{\hbar c} \cong \frac{\hbar c}{G_e m_e^2} \cong \frac{G_n^2}{G_w G_e} \cong \frac{m_p}{M_{wf}}$
4) Ratio of mean mass of pinos to mean mass of weak bosons can be,

$$\left(\frac{m_p}{M_{wf}}\right) \cong \left(\frac{\sqrt{\left(m_\pi c^2\right)^0\left(m_\pi c^2\right)^\pm}}{\sqrt{\left(m_z c^2\right)^0\left(m_w c^2\right)^\pm}}\right) \cong 0.001603$$

---

*Electronic address: *Seshavatharam.uvs@gmail.com*

5) Characteristic ratio of force ratio can be expressed as $\frac{e_n^2}{4\pi\varepsilon_0 G_n m_p m_e} \cong 4\pi^2$

Ratio of neutron-proton mass difference to electron rest mass

Based on the above results, it is very interesting to note that,

$$\left.\begin{array}{l} \left(\frac{m_n - m_p}{m_e}\right) \cong \ln(4\pi) \cong 2.531024247 \text{ and} \\ \frac{(939.5654205 - 938.27208816) \text{ MeV}}{0.51099895 \text{ MeV}} \\ \cong \frac{1.2933324 \text{ MeV}}{0.51099895 \text{ MeV}} \cong 2.530988371 \end{array}\right\}$$

Fitting bottle method of neutron lifetime

With above relations, we noticed that,

$$t_n \cong \exp\left[\frac{16\pi^2}{\ln(4\pi)}\right]\left(\frac{\hbar}{m_n c^2}\right) \cong 874.174 \text{ sec}$$

and $\ln\sqrt{\left(\frac{m_n - m_p}{m_e}\right)\ln\left(\frac{t_n m_n c^2}{\hbar}\right)} \cong 4\pi$. It

needs further study.

Understanding nuclear beta stability line for Z=2 to 92

Considering above relations, light house like stable mass numbers of Z=2 to 92 can be fitted with, $A_s \cong 2Z + \left(\frac{Z}{4\pi}\right)^2 \cong 2Z + 0.006333Z^2$. It can be modified for understadning super heavy atomic nuclides.

Understanding the root mean square radius of proton

Considering the workability of above relations, RMS radius of proton can be estimated with

$$R_p \cong \left(1 + \frac{e}{e_n}\right)\left(\frac{G_n m_p}{c^2}\right) \cong 8.3 \times 10^{-16} \text{ m}$$

Considering higher powers of $\left(\frac{e}{e_n}\right)$,

$$R_p \cong \exp\left(\frac{e}{e_n}\right)\left(\frac{G_n m_p}{c^2}\right) \cong 1.4041\left(\frac{G_n m_p}{c^2}\right).$$

Thus,

$$R_p \cong (8.3 \text{ to } 8.7) \times 10^{-16} \text{ m.}$$

Understanding the quantum of magnetic flux

Planck's constant can be expressed as $h \cong \sqrt{\left(\frac{e_n^2}{4\pi\varepsilon_0 c}\right)\left(\frac{G_e m_e^2}{c}\right)}$. Based on this result, $\left(\frac{h}{e}\right) \cong \left(\frac{e_n}{e}\right)\sqrt{\left(\frac{\mu_0}{4\pi}\right)G_e m_e^2}$. With reference to experimental magnetic flux quantum $\left(\frac{h}{2e}\right)$, factor $\left(\frac{1}{2}\right)$ is missing in this relation. It can be understood as follows. Total magnetic flux generated for one electron can be,

$$\Phi_{Total} \cong \left(\frac{e_n}{e}\right)\sqrt{\left(\frac{\mu_0}{4\pi}\right)G_e m_e^2} \cong \frac{h}{e}.$$

For a simple two-pole system, quantum of magnetic flux per pole can be,

$$\Phi_{per/pole} \cong \frac{\Phi_{Total}}{2} \cong \frac{1}{2}\left(\frac{e_n}{e}\right)\sqrt{\left(\frac{\mu_0}{4\pi}\right)G_e m_e^2} \cong \frac{h}{2e}$$

References

[1] Seshavatharam U.V.S. and Lakshminarayana S. Understanding the Origins of Quark Charges, Quantum of Magnetic Flux, Planck's Radiation Constant and Celestial Magnetic Moments with the 4G Model of Nuclear Charge. Current Physics, 1, e090524229812, 122-147, 2024.

[2] Seshavatharam U. V. S., Gunavardhana Naidu T and Lakshminarayana S. To confirm the existence of heavy weak fermion of rest energy 585 GeV. AIP Conf. Proc. 2451 p 020003, 2022.

[3] Anirban, A. Precise measurement of neutron lifetime. Rev. Phys. 4, 9, 2022.