Nucleus in Strong nuclear gravity

U. V. S. Seshavatharam[1*] and Prof. S. Lakshminarayana[2†]
[1] *Faculty member, I-SERVE, Alakapuri, Hyderabad-35, India and*
[2] *Dept. of Nuclear Physics, Andhra University, Visakhapatnam-03, India.*

Gravitational constant in β decay

Fitting the gravitational constant with atomic and nuclear physicsl constants is an interesting task. It is well established that, in β decay, neutron emits an electron and transforms to proton. Thus the nuclear charge changes and the nucleus gets stability. From the semi empirical mass formula, it is established that,

$$Z \cong \frac{A}{2 + \left(E_c/2E_a\right) A^{2/3}}. \quad (1)$$

where Z = number of protons of the stable nucleus and A =number of nucleons in the stable nucleus. E_a and E_c are the asymmetry and coulombic energy constants. Semi empirically it is noticed that,

$$A_S \cong 2Z + \frac{Z^2}{S_f} \cong 2Z + \frac{Z^2}{157.069} \quad (2)$$

Here S_f is a new number and can be called as the nuclear stability factor and A_S is stable mass number. With reference to the ratio of neutron and electron rest masses, S_f can be expressed

$$S_f \cong \sqrt{\alpha} \cdot \frac{m_n}{m_e} \cong 157.0687113 \quad (3)$$

Here α is the fine structure ratio. If Z= 21, A_S = 44.8; Z= 29, A_S = 63.35; Z=47, A_S = 108.06; Z=79, A_S = 197.73 and Z=92, A_S = 237.88. By considering A as the fundamental input its corresponding stable Z = Z_S takes the following form.

$$Z_S \cong \left[\sqrt{\frac{A}{157.069} + 1} - 1\right] 157.069 \quad (4)$$

Thus Green's stability formula in terms of Z takes the following form.

$$\frac{0.4A^2}{A + 200} \cong A_S - 2Z \cong \frac{Z^2}{S_f}. \quad (5)$$

Surprisingly it is noticed that this number S_f plays a crucial role in fitting the nucleons rest mass. Another interesting observation is that

$$\frac{\left(m_n - m_p\right) c^2}{m_e c^2} \cong \ln\left(\sqrt{S_f}\right) \quad (6)$$

Here m_n, m_p and m_e are the rest masses of neutron, proton and electron respectively. Semi empirically it is noticed that

$$\frac{E_c}{2E_a} \cdot \frac{e^{S_f}}{N} \cong \frac{e^2}{4\pi\varepsilon_0 G m_e^2} \quad (7)$$

Electron rest mass can be expressed as

$$m_e \cong \sqrt{\frac{2E_a}{E_c} \cdot \frac{N}{e^{S_f}}} \cdot \sqrt{\frac{e^2}{4\pi\varepsilon_0 G}} \quad (8)$$

Here N is the Avogadro number. $\frac{e^2}{4\pi\varepsilon_0 G m_e^2}$ is the electromagnetic and gravitational force ratio of electron. In this proposal the important questions are: What is the role of Avogadro number in β decay ? and How to interpret the expression $\sqrt{\frac{e^2}{4\pi\varepsilon_0 G}}$? This is a multipurpose expression. Either the value of Avogadro number or the value of gravitational constant can be fitted.

$$G \cong \frac{2E_a}{E_c} \cdot \frac{N}{e^{S_f}} \cdot \frac{e^2}{4\pi\varepsilon_0 m_e^2} \quad (9)$$

From the semi empirical mass formula if E_a= 23.21 MeV and E_c= 0.71 MeV, $G \cong 6.6866323 \times 10^{-11}$ $\mathrm{m^3 Kg^{-1} sec^{-2}}$. Since all other atomic constants are well measured, accuracy of G only depends upon E_a and E_c of the semi empirical mass formula.

*Electronic address: seshavatharam.uvs@gmail.com
†Electronic address: lnsrirama@yahoo.com

Nucleus in 'strong nuclear gravity'

1. N being the Avogadro number, mole number of particles effective atomic gravitational constant G_A is equal to N times the classical gravitational constant G. In mole particles, nuclear weak force magnitude for one one particle is $F_W \cong \frac{c^4}{NG_A} \cong 3.337152088 \times 10^{-4}$ newton. Nuclear strong force and weak force magnitudes can be correlated as $\sqrt{\frac{F_S}{F_W}} \cong 2\pi \ln\left(N^2\right)$. Thus $F_S \cong 157.9944058$ newton. Characteristic nuclear size is $R_0 \cong \sqrt{\frac{e^2}{4\pi\varepsilon_0 F_S}} \cong 1.208398568$ fm.

2. Nuclear weak energy constant is $E_W \cong \sqrt{\frac{e^2 F_W}{4\pi\varepsilon_0}} \cong 1.731844 \times 10^{-3}$ MeV. Nuclear strong energy constant is $E_S \cong \sqrt{\frac{e^2 F_S}{4\pi\varepsilon_0}} \cong 1.191630355$ MeV.

3. Considering the rest mass of electron, its gravitational mass generator $= X_E \cong m_e c^2 \div \sqrt{\frac{e^2}{4\pi\varepsilon_0}\left(\frac{c^4}{N^2 G}\right)} \cong 295.0606338$. Using this number, tau and muon masses can be fitted accurately as $\left(mc^2\right)_n \cong \left[X_E^3 + \left(n^2 X_E\right)^n \sqrt{N}\right]^{\frac{1}{3}} E_W$ where n = 1 and 2. At n = 1, $\left(mc^2\right) \cong 105.95$ MeV, n = 2, $\left(mc^2\right) \cong 1777.4$ MeV.

4. Proton rest mass is $m_p c^2 \cong \left(\frac{F_S}{F_W} + X_E^2 - \frac{1}{\alpha^2}\right) E_W \cong 938.1791391$ MeV. Neutron, proton mass difference is $m_n c^2 - m_p c^2 \cong \sqrt{\frac{F_S}{F_W} + X_E^2} \cdot E_W \cong 1.29657348$ MeV.

5. The proton-nucleon nuclear stability factor is $S_f \cong X_E - \frac{1}{\alpha} - 1 \cong 157.0246441$. At n = 1 and n = 2, nucleon rest energy $\cong \frac{S_f}{\sqrt{\alpha}} m_e c^2 - x\left(2^x + \frac{E_c}{2E_a}\right) m_e c^2$ where $x = (-1)^n$.

6. Weak coupling angle is $\sin\theta_W \cong \frac{1}{\alpha X_E} \cong 0.464433353 \cong \frac{\text{Up quark mass}}{\text{Down quark mass}}$. $X_S \cong \ln\left(X_E^2 \sqrt{\alpha}\right) \cong 8.91424 \cong \frac{1}{\alpha_s}$ can be considered as 'inverse of the strong coupling constant'.

7. With reference to proton rest energy, semi empirical mass formula coulombic energy is $E_c \cong \frac{\alpha}{X_S} \cdot m_p c^2 \cong \alpha \cdot \alpha_s \cdot m_p c^2 \cong 0.7681$ MeV. Pairing energy constant is $E_p \cong \frac{m_p c^2 + m_n c^2}{S_f} \cong 11.959$ MeV and asymmetry energy constant is $E_a \cong 2E_p \cong 23.918$ MeV. Volume and surface energy constants and asymmetric and pairing energy constants can be related as $E_a - E_v \cong E_s - E_p \cong (X_S + 1) E_c \cong 7.615$ MeV. $E_v + E_s \cong E_a + E_p \cong 3E_p$. Thus $E_v \cong 16.303$ MeV and $E_s \cong 19.574$ MeV. It is also noticed that, $\frac{E_a}{E_v} \cong 1 + \sin\theta_W$ and $\frac{E_a}{E_s} \cong 1 + \sin^2\theta_W$. Thus $E_v \cong 16.332$ MeV and $E_s \cong 19.674$ MeV.

8. Nuclear binding energy can be fitted with 2 terms or 5 factors with $E_c \cong 0.7681$MeV as the single energy constant. First term $= T_1 \cong (f)(A+1)\ln\left[(A+1) X_S\right] E_c$, second term $= T_2 \cong \left[\frac{A^2 + \left(f.Z^2\right)}{X_S^2}\right]^{\frac{1}{3}} E_c$ where $f \cong 1 + \frac{2Z}{A_S} \cong \frac{4S_f + Z}{2S_f + Z} < 2$ and $A_S \cong 2Z + \frac{Z^2}{S_f} \cong 2Z + \frac{Z^2}{157.025}$. Close to the stable mass number, binding energy $= T_1 - T_2$.

9. Magnetic moment of electron is $\mu_B \cong \frac{ec}{2}\sqrt{\frac{e^2}{4\pi\varepsilon_0 F_W}} \sin\theta_W$ and magnetic moment of nucleon is $\mu_n \cong \frac{ec}{2}\sqrt{\frac{e^2}{4\pi\varepsilon_0 F_S}} \sin\theta_W \cong \frac{ecR_0}{2} \sin\theta_W$ where R_0 is the unit nuclear size or nucleon size.

References

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