4G model of fitting RMS radius of proton

U.V.S. Seshavatharam[1*] and S. Lakshminarayana[2+]

[1]Honorary faculty, I-SERVE, Survey no-42, Hitech city, Hyderabad-84,Telangana, INDIA
[2]Dept. of Nuclear Physics, Andhra University, Visakhapatnam-03,AP, INDIA
Emails: [*]seshavatharam.uvs@gmail.com (and) [+]lnsrirama@gmail.com
Orcid numbers: [*]0000-0002-1695-6037 (and) [+]0000-0002-8923-772X

Abstract: In our 4G model of final unification, along with three large atomic gravitational constants pertaining to electromagnetic, strong and weak interactions, we have proposed the existence of a strong nuclear charge of magnitude $e_s \cong 2.9463591e$ and existence of electroweak fermion of rest energy $M_w c^2 \cong 584.725$ GeV. With reference to protons, pions and weak bosons, we noticed that, $\frac{m_p}{M_w} \cong \frac{\sqrt{(m_\pi)^0 (m_\pi)^\pm}}{\sqrt{(m_z)^0 (m_w)^\pm}} \cong 0.0016$ and this number seems to play a crucial role in understanding nuclear stability and binding energy. Increasing number of free nucleons, increasing nuclear radii and increasing asymmetry about stable mass number play important role in reducing the nuclear binding energy. Unified binding energy coefficient can be expressed with, $B_0 \cong \sqrt{\left(\frac{e_s^2}{8\pi\varepsilon_0(\hbar/m_p c)}\right)\left(\frac{e^2}{8\pi\varepsilon_0(\hbar/m_p c)}\right)} \cong 10.1 \text{ MeV}.$ A four term nuclear binding energy relation for $(Z \geq 3 \text{ and } N \geq Z)$ can be expressed as, $BE \cong \left\{A - \left[1 + \left(0.0016\left(\frac{Z^2 + A^2}{2}\right)\right)\right] - A^{1/3} - \frac{(A_s - A)^2}{A_s}\right\}(10.1 \text{ MeV})$ where $A_s \cong 2Z + 0.0016(2Z)^2 \cong 2Z + 0.0064Z^2$ = Estimated mass number close to stability zone. Based on these relations, we noticed a relation for fitting RMS radius of proton as, $R_p \cong \sqrt{\frac{4\pi\varepsilon_0\hbar^3}{e_s^2 m_p^2 c}} \cong \sqrt{\frac{\alpha_s}{\alpha}}\left(\frac{\hbar}{m_p c}\right) \cong 0.835 \text{ fm}$ where $\alpha_s \cong 0.1152$ represents the strong coupling constant. It needs further study.

References

[1] Seshavatharam UVS, Lakshminarayana S. On the role of four gravitational constants in nuclear structure. Mapana Journal of Sciences. 18(1):21-45,2019.
[2] Seshavatharam U.V.S, Lakshminarayana S. Implications and applications of fermi scale quantum gravity. International Astronomy and Astrophysics Research Journal. 2(1):13-30, 2020.
[3] Seshavatharam U.V.S, Lakshminarayana, S. On the Combined Role of Strong and Electroweak Interactions in Understanding Nuclear Binding Energy Scheme. Mapana Journal of Sciences, 20(1),1-18. 2021.
[4] Seshavatharam, U. V. S, Lakshminarayana, S. 4G Model of Fractional Charge Strong-Weak Super Symmetry. International Astronomy and Astrophysics Research Journal, 2(1), 31-55, 2020.
[5] Seshavatharam U.V.S, Lakshminarayana S. H. K. Cherop and K.M. Khanna**.** Three Unified Nuclear Binding Energy Formulae. World Scientific News, 163, 30-77, 2022.
[6] Seshavatharam U. V. S, Lakshminarayana S. To Confirm the Existence of Heavy Weak Fermion of Rest Energy 585 GeV. To be appeared in AIP Conf. proceedings. ICAMSER-2021, Chitkara University, India.