Hidden and Intermediate states of Nucleons

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Abstract. Nuclear planck energy is given by $\sqrt{\frac{\hbar c^5}{G_S}}$ where G_S is the strong nuclear gravitational constant [1, 2, 3] and is equal to $N^2 G_C$. Here N is Avagadro number and G_C is the classical gravitational constant. In the previous paper [1] it is suggested that there exists 2 kinds of mass units. They are observed and hidden mass units and their mass ratio is $X_E = 295.0606338$. X_E can be called as the lepton-quark mass generator [1 - 4]. In this paper this idea is applied to the nucleons. Hidden mass unit of nucleon can be given as $\frac{m_n c^2}{X_E}$. It is noticed that there exists an intermediate hidden mass state in between neutron and proton. If nuclear stability factor is defined as $S_f \cong X_E - \frac{1}{\alpha} - 1 \cong 157.0246341$, hidden mass of the intermediate state can be given as $S_f \sqrt{\frac{\hbar c^5}{G_S}} \cong S_f \times 0.020273374 \cong 3.183419183\ MeV$. Observable mass of this hidden intermediate state can be given as $S_f \left[X_E \sqrt{\frac{\hbar c^5}{G_S}}\right] \cong S_f \times 5.981874582 \cong 939.3016819\ MeV$. If $m_e c^2$ is the rest energy of electron, this observable intermediate state gains a mass-energy of $\frac{1}{2} m_e c^2$ and transforms to neutron. By loosing a mass-energy of $2 m_e c^2$ transforms to proton. Error is related with $\pm \left(\frac{E_c}{2Ea}\right) m_e c^2$. Here E_c and E_a are the semi emepirical mass formula [1, 3, 15, 16, 17] coulomb and asymmetry energy constants. Finally it is suggested that pairing energy constant of the semi empirical mass formula is $E_p \cong 2 \times 5.981874582 \cong 11.96374916\ MeV$. Asymmetry energy constant $E_a \cong 2E_p \cong 23.92749833\ MeV$. E_c, E_a are related with X_E as $\sqrt{\frac{E_a}{E_c} + 1} \cong \ln(X_E)$. Volume and surface energy constants are related as $E_a - E_v \cong E_s - E_p \cong 2 \ln\left(\frac{X_E}{2}\right) E_c$.

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1. Nuclear planck energy and coulomb energy

It is assumed [1] that, the nuclear space time curvature is due to the nuclear charge and the strong nuclear gravitational constant [5 -12] (G_S)*. It can be given as*

$$G_S \cong N^2\ G_C \cong 2.420509614 \times 10^{37}\ \ N.meter^2/Kg^2. \tag{1}$$

Here, G_C*= classical or cosmic gravitational constant* $\cong 6.6742867{\times}10^{-11}\ \ N.meter^2/Kg^2$. $N =$ *Avagadro number* $\cong 6.022141793 \times 10^{23}$*. Till now avagadro number [13] is a mystery. 'Why there are N atoms in a mole' is still an lessanswer question. Authors wish to say that, existence of the classical gravitational constant* (G_C) *is a consequence of the existence of the strong nuclear gravitational constant* (G_S)*.*

Similar to the planck [14] mass-energy $\sqrt{\frac{\hbar c^5}{G_C}}$ *in nuclear physics nuclear planck mass-energy can be given as*

$$\sqrt{\frac{\hbar c^5}{G_S}} \cong 0.020273374\ MeV. \tag{2}$$

Its corresponding coulomb energy [5 -7] can be given as

$$\sqrt{\frac{e^2 c^4}{4\pi\epsilon_0 G_S}} \cong 0.001731843734\ MeV. \tag{3}$$

It is suggested that [1, 2] the hidden mass of the electron is nothing but the $\sqrt{\frac{e^2}{4\pi\epsilon_0 G_S}}$*. Ratio of observed and hidden mass units of electron is* $X_E \cong 295.0606338$*. Considering these 2 mass units in this paper an attempt is made to fit the nucleons rest mass upto 5 or 6 decimal places.*

2. Nuclear stability factor

Let E_a = *asymmetry energy constant,* E_p = *pairing energy constant,* E_v = *volume energy constant,* E_s = *surface energy constant and* E_c = *coulomb energy constant. In the previous papers [1, 3] it is suggested that the nuclear stability factor is*

$$S_f \cong \frac{E_a}{E_c}\sqrt{\frac{E_s}{E_c}} \cong 157.147. \tag{4}$$

In this paper it is defined as

$$S_f \cong X_E - \frac{1}{\alpha} - 1 \cong 157.0246341. \tag{5}$$

With this number proton-neucleon stability [17] can be given as

$$A_S \cong 2Z + \frac{Z^2}{S_f} \cong 2Z + \frac{Z^2}{157.025}. \tag{6}$$

Obtained data can be compared with the existing stability relation

$$Z_S \cong \frac{A}{2 + 0.0157A^{\frac{2}{3}}}. \tag{7}$$

Z	A_S	Correction
Even	Even	± 2
Even	odd	± 1
Odd	even	± 1
Odd	odd	± 2

Table 1. Even-odd correction for the obtained A_S.

Z	A_S	Correction
17	36	± 1
21	45	± 2
25	54	± 1
29	63	± 2
47	108	± 1
59	140	± 1
69	168	± 1
79	198	± 1
83	210	± 1
92	238	± 2

Table 2. Fitting of proton-nucleon stability.

By considering A as the fundamental input its corresponding stable $Z = Z_S$ can be obtained as

$$Z_S \cong \left[\sqrt{\frac{A}{157.025}+1}-1\right] 157.025. \tag{8}$$

See table 1 and table 2 for even odd correction of the obtained stable mass number. It is noticed that

$$\frac{4E_a}{E_c} \cong \frac{E_a}{E_c}\left(\sqrt{\frac{E_s}{E_c}}-1\right) \cong S_f - \frac{E_a}{E_c}. \tag{9}$$

surprisingly it is noticed that this number S_f plays a crucial role in fitting the nucleons rest mass.

3. Hidden intermediate state of the nucleons

It is suggested that there exists a hidden intermediate mass state of the nucleons. Its mass energy can be given as

$$E_X \cong m_X c^2 \cong S_f \sqrt{\frac{\hbar c^5}{G_S}} \cong 3.183419183 \; MeV. \tag{10}$$

With reference to this mass unit its observable intermediate mass state can be given as

$$E_I \cong m_I c^2 \cong S_f \left[X_E \sqrt{\frac{\hbar c^5}{G_S}}\right] \cong \frac{S_f}{\sqrt{\alpha}} m_e c^2 \cong 939.3016819 \; MeV. \tag{11}$$

Z	A	Obtained Be, MeV
6	12	86.4
11	23	185.97
26	56	491.30
44	100	863.83
59	141	1176.37
69	169	1372.50
79	197	1555.29
82	208	1625.68
92	238	1804.11
108	292	2095.95

Table 3. Fitting of nuclear binding energy with proposed energy constants.

If m_ec^2 is the rest energy of electron, this observable intermediate state gains a mass-energy of $\frac{1}{2}m_ec^2$ and transforms to neutron. By loosing a mass-energy of $2m_ec^2$ transforms to proton. Error is related with $\pm\left(\frac{E_c}{2Ea}\right)m_ec^2$. Here E_c and E_a are the semi emepirical mass formula coulomb and asymmetry energy constants.

4. Semi empirical mass formula energy constants [15, 16, 17]

It is suggested that

$$E_p \cong 2\left[X_E\sqrt{\frac{\hbar c^5}{G_S}}\right] \cong 11.96374935\ MeV. \quad (12)$$

$$E_a \cong 2E_p \cong 23.92749869\ MeV. \quad (13)$$

$$\sqrt{\frac{E_a}{E_c}+1} \cong \ln\left(X_E\right) \quad and \quad E_c \cong 0.763383059\ MeV. \quad (14)$$

$$E_a - E_v \cong E_s - E_p \cong 2\ln\left(\frac{X_E}{2}\right)E_c \cong 7.624721443\ MeV. \quad (15)$$

$$E_a + E_p \cong E_v + E_s \cong 3E_p \cong 35.89124805\ MeV. \quad (16)$$

It can be given as E_v=16.30277725 MeV and E_s=19.58847079 MeV.
The semi empirical mass formula is

$$Be \cong AE_a - A^{\frac{2}{3}}E_s - \frac{Z\left(Z-1\right)}{A^{\frac{1}{3}}}E_c - \frac{\left(A-2Z\right)^2}{A}E_a \pm \frac{1}{\sqrt{A}}E_p. \quad (17)$$

See the following table 3.

5. Neutron and proton rest masses

Considering neutron and proton as 2 different quantum states at n=1 and n=2 it is noticed that

$$m_n c^2 \cong S_f \left[X_E \sqrt{\frac{\hbar c^5}{G_S}} \right] - x \left(2^x + \frac{E_c}{2E_a} \right) m_e c^2. \tag{18}$$

where, $x = (-1)^n$ *and n=1 or 2. For n=1, x= -1 and n=2, x= +1.*
At n=1, neutron rest mass-energy can be given as

$$m_N c^2 \cong S_f \left[X_E \sqrt{\frac{\hbar c^5}{G_S}} \right] + \left(\frac{1}{2} + \frac{E_c}{2E_a} \right) m_e c^2 \cong 1.674927188 \times 10^{-27} c^2 \ Kg \cong 939.5653328 \ MeV. \tag{19}$$

At n=2, proton rest mass-energy can be given as

$$m_P c^2 \cong S_f \left[X_E \sqrt{\frac{\hbar c^5}{G_S}} \right] - \left(2 + \frac{E_c}{2E_a} \right) m_e c^2 \cong 1.67262078 \times 10^{-27} c^2 \ Kg \cong 938.2715326 \ MeV. \tag{20}$$

These obtained mass units can be compared with the experimental values upto 6 decimal places. Empirically it is also noticed that,

$$m_P c^2 \cong \left[e^{X_S \sqrt{\Psi}} - \left(\frac{X_E - 1}{2} \right)^2 - \ln \left(\frac{X_E - 1}{2} \right)^2 \right] \sqrt{\frac{e^2 c^4}{4\pi\epsilon_0 G_S}}. \tag{21}$$

$$(m_N - m_P) c^2 \cong \sqrt{e^{X_S \sqrt{\Psi}} - e^{X_S}} \sqrt{\frac{e^2 c^4}{4\pi\epsilon_0 G_S}} \cong 1.2922209 \ MeV. \tag{22}$$

Here, $X_S \cong \frac{1}{2}\sqrt{\frac{G_S M_{Hf}^2}{\hbar c}}$ *=strong interaction mass generator=8.803723453.* $M_{Hf}c^2$*= hidden mass unit of* $M_{Sf}c^2 \cong \frac{M_{Sf}c^2}{X_E}$*. Note that* $M_{Sf}c^2 \cong 105.3255407$ *MeV is the proposed [1, 2, 3, 4] strongly interacting fermion.* $\Psi \cong \left(6 + \sqrt{13}\right)$*= super symmetric [4] fermion-boson mass ratio=2.262341189. Obtained values are* $m_P c^2$*=938.2711219 MeV and* $m_N c^2$*=939.5633428 MeV.*

Conclusions

Observed and hidden mass concepts can be studied in a progressive way. Proposed method of nucleons rest mass fitting can be given a chance in nuclear physics. Sum of the up and down quarks mass is not matching with the nucleons rest mass. Presently believed up and down quark masses can be assumed as their hidden masses. It can be suggested that existence of the proposed strong nuclear gravitational constant is true.

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