# Is proton the harmonic mean of up and down quark fermi-gluons!


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**Abstract.** The revised [1] up quark mass is $U_f c^2 \cong 4.400744112\ MeV$ and down quark mass is $D_f c^2 \cong 9.475512637\ MeV$. With reference to the proposed [1, 2, 3, 4] strongly interacting sub quark fermion having mass $M_{Gf} c^2 \cong 11449.25273\ MeV$ up fermi-gluon mass can be given as $U_{Fg} c^2 \cong \left[ (M_{Gf})^2 \times U_f \right]^{\frac{1}{3}} c^2 \cong 832.4537875\ MeV$ and down fermi-gluon mass can be given as $D_{Fg} c^2 \cong \left[ (M_{Gf})^2 \times D_f \right]^{\frac{1}{3}} c^2 \cong 1074.943571\ MeV$. It is noticed that harmonic mean mass of up fermi-gluon and down fermi-gluon is 938.2846662 MeV. This mass unit is coinciding with the proton rest up to 4 decimal places as $1.672644193 \times 10^{-27}\ Kg$. Not only that ratio of up and down quarks harmonic mean mass and neutron-proton mass difference is close to the squared ratio of down and up quark masses. Qualitatively with these two observations origin of nucleons rest mass can be understood. Alternatively proposed up and down quark masses can be confirmed. Existence of the proposed 11449 MeV sub quark fermion [1, 2, 3, 4] and the procedure for obtaining the quark fermi-gluon masses can be considered for further analysis positively. Finally it can be suggested that nuclear physics can be studied in the view of 'strong nuclear gravity' where nuclear charge and strong nuclear gravitational constant play a crucial role in the nuclear space-time curvature, QCD and quark confinement [1 - 6, 10-17].



## Keywords

Strong nuclear gravity; strong nuclear and classical gravitational constants; avagadro number; lepton-quark-nuclear mass generator; fine structure ratio; integral charge quark fermion; integral charge quark fermi-gluon; proton rest mass; neutron rest mass; semi empirical mass formula;

## 1. Introduction

Estimated or phenomenological [7, 8] masses of up and down quarks are 1.3 to 3.3 MeV and 4.1 to 5.8 MeV respectively. Standard model assumes that proton constitutes 2 up quarks and one down quark. Neutron constitutes 2 down quarks and one up quarks. In any way their estimated or phenomenological [7, 8] mass sum is not matching with the nucleons rest mass. In any way their sum is not matching with the nucleons rest energy. There should be some reason for this mismatch. This clearly indicates that there is something missing from the standard model. In standard model there exists 8 gluons having 'color' charge with no rest mass and in between the quarks strong interaction is mediated by these gluons. If gluons has no rest mass and up and down quarks mass sum is small (compared to the nucleon rest mass) how to generate the existing nucleon rest mass? To over come this difficulty [1] it is suggested that there exists integral charge quark fermions, integral charge quark bosons, integral charge (massive) quark fermi-gluons and integral charge (massive) quark boso-gluons. Note that fermi-gluon means massive gluons having fermion behavior and boso-gluon means massive gluons having boson behavior. (Effective) fermi-gluons play a crucial role in baryons mass generation and boso-gluons play a crucial role in mesons mass generation.

## 2. Strong nuclear gravity

Stephen Hawking - in his famous book- "A brief history of time" [10] says: It would be very difficult to construct a complete unified theory of everything in the universe all at one go. So instead we have made progress by finding partial theories that describe a limited range of happenings and by neglecting other effects or approximating them by certain numbers. (Chemistry, for example, allows us to calculate the interactions of atoms, without knowing the internal structure of an atomic nucleus.) Ultimately, however, one would hope to find a complete, consistent, unified theory that would include all these partial theories as approximations, and that did not need to be adjusted to fit the facts by picking the values of certain arbitrary numbers in the theory. The quest for such a theory is known as "the unification of physics". Einstein spent most of his later years unsuccessfully searching for a unified theory, but the time was not ripe: there were partial theories for gravity and the electromagnetic force, but very little was known about the nuclear forces. Moreover, Einstein refused to believe in the reality of quantum mechanics, despite the important role he had played in its development.

The subject of 'strong nuclear gravity' is new and is in its birth state. Surprising thing is that many modern physics journals treats this important subject as 'out of scope'. Even some professors say- it is an unconventional subject. But the subject of unifying the four observed interactions requires a scientific platform and is a must. In this connection authors request the science community to kindly refer to the beautiful works of A. Salam and Einstein [11-15]. For a black hole at the event horizon every thing is entrapped. It means no particle can be observed at the black hole surface.

This concept seems to be similar to the 'quark confinement'. To make it real one must assign a large numerical value to the existing classical gravitational constant $(G_C)$. Large value of the classical gravitational constant can be called as the 'strong nuclear gravitational constant' $(G_S)$. Just like plant-seed or chicken-egg problem, then the utmost fundamental question to be answered is - Which is primary either $(G_S)$ or $(G_C)$? Then (nuclear) elementary charge and the strong gravitational constant jointly generates the nuclear space-time curvature and entraps the quarks. Based on quantum mechanical principles just like 'tunneling effect' some effects can be observed.

In strong nuclear gravity [2 - 6] it is suggested that the nuclear space time curvature is due to the nuclear charge and the strong nuclear gravitational constant $(G_S)$. It can be given as $G_S \cong N^2\ G_C \cong 2.420509614 \times 10^{37}\ \ N.meter^2/Kg^2$ where, $G_C=$ classical or cosmic gravitational constant $\cong 6.6742867 \times 10^{-11}\ \ N.meter^2/Kg^2$ and $N$ is the Avagadro number. If avagadro number is having a real significance in fundamental physics, 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 $(G_S)$.

## 3. The quark, lepton and nuclear mass generator

Note that $X_E \cong 295.0606338$ is a number and can be called as the quark, lepton and nuclear mass generator. Its origin is related with strong nuclear gravity [2 - 5]. Using this number charged lepton masses, quark masses and the nuclear mass can be generated. $X_E$ can be given as

$$X_E \cong N\sqrt{\frac{4\pi\epsilon_0 G_C m_e^2}{e^2}} \cong \sqrt{\frac{4\pi\epsilon_0 G_S m_e^2}{e^2}} \cong 295.0606338. \tag{1}$$

Here $m_e$ is the rest mass of electron. Note that $\sqrt{\frac{e^2}{4\pi\epsilon_0 G_S}} \cong 3.087291597 \times 10^{-33}\ kg \cong 1.731844 \times 10^{-3}\ MeV$ can be called as the'hidden mass' of electron [4].

### *3.1. Charged lepton rest masses*

Using this number charged lepton masses [2, 3] can be fitted as

$$m_l c^2 \cong \left[X_E^3 + \left(n^2 X_E\right)^n \sqrt{N}\right]^{\frac{1}{3}}\ 1.732 \times 10^{-3}\ MeV. \tag{2}$$

where n= 0,1 and 2.

| n | Obtained Lepton mass, MeV | Exp. Lepton Mass, MeV |
|---|---|---|
| 0 | Defined | 0.510998922 |
| 1 | 105.951 | 105.658369 |
| 2 | 1777.384 | 1776.84 ±0.17 |

**Table 1.** Fitting of charged lepton rest masses.

## 4. Semi empirical mass formula binding energy constants

Let $E_p$ = pairing energy constant, $E_a$ = asymmetry energy constant, $E_v$ = volume energy constant, $E_s$ = surface energy constant and $E_c$ = coulomb energy constant. The famous semi empirical mass formula binding energy constants [5, 18, 19, 20] can be given as

$$E_p \cong 2\left[X_E\sqrt{\frac{\hbar c^5}{G_S}}\right] \cong 11.96374935\ MeV. \tag{3}$$

$$E_a \cong 2E_p \cong 23.92749869\ MeV. \tag{4}$$

$$\sqrt{\frac{E_a}{E_c}+1} \cong \ln(X_E) \quad and \quad E_c \cong 0.763383059\ MeV. \tag{5}$$

$$E_a - E_v \cong E_s - E_p \cong 2\ln\left(\frac{X_E}{2}\right)E_c \cong 7.624721443\ MeV. \tag{6}$$

$$E_a + E_p \cong E_v + E_s \cong 3E_p \cong 35.89124805\ MeV. \tag{7}$$

It can be given as $E_v$=16.30277725 MeV and $E_s$=19.58847079 MeV.
In ths way semi empirical mass formula can be coupled with 'strong nuclear gravity'. The semi empirical mass formula is

$$Be \cong AE_a - A^{\frac{2}{3}}E_s - \frac{Z(Z-1)}{A^{\frac{1}{3}}}E_c - \frac{(A-2Z)^2}{A}E_a \pm \frac{1}{\sqrt{A}}E_p. \tag{8}$$

## 5. Estimation of up and down quark masses

It is suggested [1] that,

$$U_f c^2 \cong e^{\alpha X_E} \times m_e c^2 \cong 4.40744112\ MeV. \tag{9}$$

Here $\alpha \cong 7.297352537 \times 10^{-3}$= fine structure ratio and $m_e c^2 \cong 0.51099891\ MeV \cong$ *electron rest energy.*

$$\frac{Down\ Quark\ mass}{Up\ Quark\ mass} \cong \frac{D_f}{U_f} \cong \alpha X_E \cong \frac{1}{\sin(\theta_W)}. \tag{10}$$

In this way $\sin(\theta_W)$ can be related with up and down quark mass ratio. Hence $D_f c^2 \cong (\alpha X_E) U_f c^2 \cong 9.475512637\ MeV.$

## 6. Strongly interacting sub quark fermion $M_{Gf}c^2$

In the paper [1] it is suggested there exists a strongly interacting sub quark fermion having rest energy close to 11450 MeV. This mass unit plays a crucial role in the mass generation of massive quark fermi gluons and quark boso-gluons. Empirically it is expressed as [1]

$$M_{Gf}c^2 \cong \left[\frac{1}{2\alpha}\right]^3 \times \sqrt{\frac{m_e c^2}{M_{Sf}c^2}} \times m_e c^2 \cong 11449.25273\ MeV. \tag{11}$$

Here $M_{Sf}c^2 \cong 105.3255407\ MeV$ is the proposed strongly interacting nuclear fermion [2, 3, 4]. It is noticed that

$$\left(U_f D_f^2\right)^{\frac{2}{3}} c^2 \cong M_{Sf}c^2 \times m_e c^2. \qquad (12)$$

## 7. Up and down quark fermi-gluons

It is suggested that [1] for any quark its corresponding fermi-gluon mass can be given as

$$Q_{Fg}c^2 \cong \left[(M_{Gf})^2 \times Q_f\right]^{\frac{1}{3}} c^2. \qquad (13)$$

Here, $Q_f$ is quark fermion mass and $Q_{Fg}$ is its corresponding fermi-gluon mass. For up and down quarks their fermi-gluon masses can be given as

$$U_{Fg}c^2 \cong \left[(M_{Gf})^2 \times U_f\right]^{\frac{1}{3}} c^2 \cong 832.4537875\ MeV. \qquad (14)$$

$$D_{Fg}c^2 \cong \left[(M_{Gf})^2 \times D_f\right]^{\frac{1}{3}} c^2 \cong 1074.943571\ MeV. \qquad (15)$$

Here nucleons rest mass seems to lie in between up and down fermi-gluons rest mass. Authors showed the applications of quark fermi-gluons in estimating or fitting the baryons rest mass [1, 6].

## 8. Proton rest mass

The co-data recommended [8, 9 ] values are proton rest mass $= m_P = 1.672621637 \times 10^{-27}$ Kg and neutron rest mass $= m_N = 1.674927211 \times 10^{-27}$ Kg.
Harmonic mean mass of up and down quark fermi-gluons can be given as

$$\left(\frac{2U_{Fg}D_{Fg}}{U_{Fg} + D_{Fg}}\right) c^2 \cong 938.2846662\ MeV. \qquad (16)$$

Geometric mean mass of up and down quark fermi-gluons can be given as

$$\sqrt{U_{Fg}D_{Fg}}\, c^2 \cong 945.9602775\ MeV. \qquad (17)$$

Average mass of up and down quark fermi-gluons can be given as

$$\left(\frac{U_{Fg} + D_{Fg}}{2}\right) c^2 \cong 953.698679\ MeV. \qquad (18)$$

Out of these 3 obtained mean masses, harmonic mean mass is coinciding with the rest mass of proton accurately! This may be the secret of origin of rest mass of proton. It is experimentally established that proton is more stable than the neutron. Obtained harmonic mean mass is $1.672644193 \times 10^{-27}\ Kg$. This is matching with the proton rest mass up to 4 decimal places.

## 9. Neutron - proton mass difference

Harmonic mean mass of up and down quarks is

$$\left(\frac{2U_f D_f}{U_f + D_f}\right) c^2 \cong 6.010166459 \; MeV. \tag{19}$$

It is noticed that

$$\left(\frac{U_f}{D_f}\right)^2 \times \left(\frac{2U_f D_f}{U_f + D_f}\right) c^2 \cong 1.296382928 \; MeV \tag{20}$$

This is close to the neutron-proton mass difference. If this is true neutron mass can be given as $m_N c^2 \cong 939.5810491 \; MeV \cong 1.674955205 \times 10^{-27} \; Kg$. This is matching with the neutron rest mass up to 4 decimal places.

## Conclusions

In this paper with the proposed ideas proton and neutron rest masses are fitted up to 4 decimal places. Proposed up and down quark masses can be confirmed. With this coincidence in nuclear physics existence of the strong nuclear gravitational constant can be confirmed. Authors humbly request the world science community to kindly look into these new and heuristic ideas for further analysis and development.

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