Scale Independent Workable Model of Final Unification

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Abstract We show that, Schwarzschild radius of Planck mass plays a vital role in electroweak and strong interactions. With reference to the observed large proportionality ratio, $0.1153\left(\frac{m_p}{m_e}\right)^{12}$, it seems appropriate to consider a large nuclear gravitational constant, $G_s \approx 3.3295608 \text{m}^3\text{kg}^{-1}\text{sec}^{-2}$. Qualitatively this idea is in agreement with “Strong gravity” concept proposed by Abdus Salam and C.Sivaram [Mod. Phys. Lett., A8(4), 321- 326. (1993)]. We would like to suggest that, by replacing the Newtonian gravitational constant with the proposed nuclear gravitational constant, predicted high energy levels of String theory can be brought down to the current hadronic scale. Based on this idea, we defined the nuclear Planck mass, $m_{npl} \approx \sqrt{\frac{\hbar c}{G_s}} \approx 546.7 \text{MeV}/c^2$ and proposed a quantized model mechanism for understanding the hadronic mass spectrum.

Keywords Final Unification, Nuclear Gravitational Constant, Newtonian Gravitational Constant, String Theory, Nuclear Planck Mass, Neutral Charge Nuclear Dark Baryon, Quantized Hadronic Mass Spectrum

1. Introduction

A Grand Unified Theory (GUT) is a model in particle physics in which at high energy, the three gauge interactions of the Standard Model which define the electromagnetic, weak, and strong interactions, are merged into one single force. Unifying gravity with the other three interactions would provide a theory of everything (TOE) [1-4]. In general, GUT is often seen as an intermediate step towards a TOE. The most desirable cases of any unified description [4] are:

1) To simplify the complicated issues of known physics.
2) To predict new effects, arising from a combination of the fields inherent in the unified description.

So far it has never been achieved. In this paper, we geared up the following things.

A). By considering the Schwarzschild radius of Planck mass and proton-electron mass ratio, we proposed very simple relations among the Newtonian gravitational constant, Fermi’s weak coupling constant, Strong coupling constant and nuclear charge radius.

B). With reference to the proposed semi empirical relations, it is possible to show that, proportionality ratio is of the order of $0.1153\left(\frac{m_p}{m_e}\right)^{12}$.

C). By replacing the large proportionality ratio with a large gravitational constant, $G_s \approx 3.3295608 \text{m}^3\text{kg}^{-1}\text{sec}^{-2}$, assumed to be associated with nuclear structure, we eliminated the higher powers of proton-electron mass ratio and proposed unified and simplified semi empirical relations.

D). By replacing the Newtonian gravitational constant with the proposed nuclear gravitational constant, we defined the nuclear Planck mass, $m_{npl} \approx \sqrt{\frac{\hbar c}{G_s}} \approx 546.7 \text{MeV}/c^2$ and developed a quantized model mechanism for understanding the hadronic mass spectrum.

2. Conceptual Thought Connected with Final Unification

Conceptual thought: Schwarzschild radius of Planck mass plays a vital role in electroweak and strong interactions.

Let, $G_N \approx 6.67408 \times 10^{-11} \text{m}^3\text{kg}^{-1}\text{sec}^{-2}$.

Planck mass $M_{pl} \approx \sqrt{\frac{\hbar c}{G_N}} \approx 2.176471826 \times 10^{-8} \text{kg}$

$R_{spl} \equiv \text{Schwarzschild radius of Planck mass}$

$\equiv \frac{2G_N m_{pl}}{c^2} \approx 2 \sqrt{\frac{G_N \hbar}{c^3}} \approx 3.2324592 \times 10^{-35} \text{m}$

3. Strange Result Connected with Planck Scale Schwarzschild Radius

Let, $\left(\frac{m_p}{m_e}\right)$ be the proton-electron mass ratio and $G_F$ be
the Fermi’s weak coupling constant. 
It is noticed that,
\[
\left(\frac{m_p}{m_e}\right)^{10} \cong \left(\frac{G_F}{\hbar c^2}\right)^{10} \cong \left(\frac{G_F c^2}{4G_N h^2}\right)^{10}
\]
(1)

Based on this relation,
\[
G_F \cong \left(\frac{m_p}{m_e}\right)^{10} \left(\frac{4G_N h^2}{c^2}\right) \cong 1.438965 \times 10^{-62} \text{ J.m}^3
\]
(2)

\[
G_N \cong \left(\frac{m_p}{m_e}\right)^{10} \left(\frac{G_F c^2}{4h^2}\right)
\]
(3)

\[
\frac{G_F}{G_N} \cong \left(\frac{m_p}{m_e}\right)^{10} \left(\frac{4h^2}{c^2}\right)
\]
(4)

If, recommended \( G_F \cong 1.435850984 \times 10^{-62} \text{ J.m}^3 \), obtained \( G_N \cong 6.65963739 \times 10^{-11} \text{ m}^3 \text{kg}^{-1} \text{sec}^{-2} \)

4. Strange Result Connected with Fermi’s Weak Coupling Constant

Let, \( R_0 \approx 1.24 \text{ fm} \) be the nuclear charge radius. 
It is noticed that,
\[
\left(\frac{m_p}{m_e}\right)^{10} \cong \sqrt{\frac{\hbar c R_0}{G_F}}
\]
(5)

From relations (1) and (5),
\[
R_0 \cong \left(\frac{m_p}{m_e}\right)^6 \frac{\pi R_{spl}^2}{\pi R_{spl}^2} \cong \left(\frac{m_p}{m_e}\right)^6 R_{spl}^2
\]
(6)

\[
\frac{R_0}{R_{spl}} \cong \left(\frac{m_p}{m_e}\right)^6 \left(\frac{\pi R_{spl}^2}{\pi R_{spl}^2}\right) \cong \left(\frac{m_p}{m_e}\right)^{12}
\]
(7)

If, \( G_N \cong 6.67408 \times 10^{-11} \text{ m}^3 \text{kg}^{-1} \text{sec}^{-2} \), obtained \( R_0 \cong 1.238755 \text{ fm} \).

5. Strange Result Connected with Strong Coupling Constant

Let, \( \alpha_s \approx 0.1153 \) be the strong coupling constant. 
It is noticed that,
\[
\left(\frac{m_p}{m_e}\right)^{12} \cong \frac{\hbar c}{\alpha_s G_N m_p^2}
\]
(8)

From relations (6) and (7)
\[
\alpha_s \cong \left(\frac{m_p}{m_e}\right)^{12} \frac{\hbar c}{G_N m_p^2} \cong \left(\frac{R_{spl}}{R_0}\right)^2 \frac{\hbar c}{G_N m_p^2}
\]
(9)

From above relations, we would like to say that, magnitude of \( \alpha_s \) seems to be around 0.1153. The same conclusion can also be extracted from Particle data group’s (PDG) review on Quantum chromodynamics [5]. See the following table-1.

6. To Eliminate the Higher Powers of Proton-electron Mass Ratio

It is true that, unless stringent requirements are met, in general, speculative alternatives to currently accepted theories cannot be accepted or published. Scientific papers having content that lie outside the mainstream of current research must justify by including a clear, detailed discussion of the motivation for the new speculation, with reasons for introducing any new concepts. If the new formulation results are in contradiction with the accepted theory, then there must both be a discussion of which experiments could be done to verify that the conventional theory needs improvement, and also an analysis showing the consistency of the new theory with the existing experiments.

### Table 1. Magnitude of \( \alpha_s \) close to 0.1153

| \# | \( \alpha_s \left(\frac{M_Z}{\alpha}\right) \) |
|---|---|
| 1 | 0.1161 \( \pm 0.0041 \) |
| 2 | 0.1151 \( \pm 0.0093 \) |
| 3 | 0.1148 \( \pm 0.0014 \) \( \text{(exp.)} \) \( \pm 0.0018 \) \( \text{(PDF)} \) |
| 4 | 0.1134 \( \pm 0.0011 \) |
| 5 | 0.1142 \( \pm 0.0023 \) |
| 6 | 0.1151 \( \pm 0.0033 \) |
| 7 | 0.1158 \( \pm 0.0035 \) |
| 8 | 0.1154 \( \pm 0.0020 \) |
| 9 | 0.1131 \( \pm 0.0028 \) |
| 10 | 0.1156 \( \pm 0.0021 \) |
| 11 | 0.1156 \( \pm 0.0041 \) |
| 12 | 0.1151 \( \pm 0.0093 \) |
In this context, by considering a proportionality ratio of $0.1153\left(\frac{m_p}{m_e}\right)^{12}$, we propose the following workable assumption: In nuclear structure, there exists a very large gravitational constant, $G_e \approx 3.3295608 \text{ m}^3\text{kg}^{-1}\text{sec}^{-2}$. We estimated this magnitude by the following ad-hoc relation.

$$\alpha_s \equiv \left(\frac{2\hbar}{m_p R_0 c}\right)^2 \equiv \left(\frac{\hbar c}{G_e m_p^2}\right)^2 \approx 0.1153 \quad (11)$$

**Application-2**

Proton rest mass, $m_p \equiv \left(\frac{G_e}{G_N}\right)^{\frac{1}{10}} m_e \equiv \left(\frac{G_e m_p^2}{G_N m^{\text{npl}}_{m^2}}\right)^{\frac{1}{10}} m_e$ where $\sqrt{\frac{\hbar c}{G_e}} \approx 546.7 \text{ MeV}/c^2 \equiv \text{Nuclear Planck mass} \equiv m_{\text{npl}}$.

**Application-3**

Nuclear charge radius,

$$R_0 \equiv \frac{2G_e m_p}{c^2} \approx 1.238755 \text{ fm} \quad (13)$$

**Application-4**

Root mean square radius of proton,

$$R_p \equiv \frac{\sqrt{2G_e m_p}}{c} \approx 0.875932 \text{ fm} \quad (14)$$

**Application-5**

Fermi's Weak coupling constant,

$$G_F \equiv \frac{2G_e m_p}{c^4} \approx \frac{4G_e^2 m_p^2 \hbar}{c^3} \approx G_e m_e^2 \left(\frac{4G_e \hbar}{c^3}\right) \quad (15)$$

where $\sqrt[3]{\frac{4G_e \hbar}{c^3}} \approx \frac{2G_e m^{\text{npl}}}{c^2} \approx 0.36 \text{ fm} \equiv \text{Nuclear Planck length}$. 

**Application-6**

Stable mass number,

$$A_s \equiv 2Z + \left(\frac{G_e m_p m_e}{\hbar c}\right) (2Z)^2 \approx 2Z + 0.00642 (Z)^2 \quad (16)$$

**Application-7**

For $Z \geq 30$, close to stable atomic nuclides, nuclear binding energy [18],

$$\langle BE\rangle_A \equiv -Z \left(\left[\frac{3 \sqrt[3]{e^2}}{5 \sqrt{4\pi\hbar R_p}} \left(\frac{3 G_e m_p^2}{5 R_p}\right)\right] \approx -Z \times 19.8 \text{ MeV} \quad (17)$$

**Application-8**

Neutron weak decay,

$$\left(\frac{m_n - m_p}{c^2} \right) \times t_n \approx \left(\frac{G_e m_p^2}{c}\right) \quad (18)$$
where, \(\left(\frac{\sqrt{M_{pl}m_e}}{m_p}\right)^3 \approx 5.9658075 \times 10^{23} \approx N_A\) is very close to Avogadro number.

**Application-9**

Weak coupling angle and up-down quark mass ratio,
\[
\sin \theta_w \approx \sqrt{\frac{4\pi \alpha G_{\mu} m_p m_e}{e^2}} \approx \left(\frac{m_u}{m_d}\right) \approx 0.46893
\]
(19)

where, \(m_u, m_d\) represent up and down quark masses respectively.

Magnetic dipole moment of proton,
\[
\mu_{\text{proton}} \approx \left(\frac{m_u}{m_d}\right)^{\frac{3}{2}} \left(\frac{e G_{\mu} m_p}{c}\right) \approx 1.3957 \times 10^{-26} \text{ J/T esla}
\]
(20)

Magnetic dipole moment of neutron,
\[
\mu_{\text{neutron}} \approx \left(\frac{m_u}{m_d}\right)^{\frac{3}{2}} \left(\frac{e G_{\mu} m_p}{c}\right) \approx 9.57 \times 10^{-27} \text{ J/T esla}
\]
(21)

**Application-11**

A). If \((M_{\text{NS}}, m_e)\) represent the masses of neutron star and neutron, then,
\[
\frac{G_N m_{\text{NS}} m_n}{h c} \approx G_i \sqrt{\frac{G_N}{G_i}}
\]
(21)

B). If \(R_{\text{NS}}\) represents the neutron star radius, then,
\[
\frac{R_{\text{NS}}}{\sqrt{G_N h / e^3}} \approx G_i \sqrt{\frac{G_N}{G_i}}
\]
(22)

**Application-12**

Planet’s earth’s magnetic moment,
\[
\mu_{\text{earth}} \approx \left(\frac{\mu_{\text{proton}}}{\mu_{\text{electron}}}\right) \left(\frac{e G_{\mu} M_{\text{earth}}}{2e}\right) \approx 8.15 \times 10^{22} \text{ J. Tesla}^{-1}
\]
(23)

**Application-13**

From relations (10) and (12), Newtonian gravitational constant,
\[
G_N \approx \left(\frac{m_u}{m_p}\right)^{\frac{12}{14}} \left(\frac{G_i^2 m_p^2}{h c}\right) \approx \left(\frac{h c}{m_p}\right)^{\frac{14}{14}} \left(\frac{4\pi \alpha G_{\mu} h c}{e^2}\right)^{\frac{1}{14}} \left(\frac{h c}{m_p^2}\right) \approx 6.679856051 \times 10^{-11} \text{ m}^3\text{kg}^{-1}\text{sec}^{-2}
\]
(24)

All these relations clearly indicate and establish the role of the proposed large nuclear gravitational constant. It may be noted that.

1) Relation (11) is a very simple relation pertaining to strong coupling constant.
2) Relation (12) indicates the massive origin of proton and needs special attention.
3) Relation (13) is a direct consequence of relation (11).
4) Relation (14) is a best fit for the recommended value of the root mean square radius of proton.
5) Relation (15) is a best fit in electroweak sector.
6) Relations (16) and (17) clearly indicate the simplified versions of nuclear stability and binding energy.
7) Relation (18) seems to be a good clue in understanding the weak decay of neutron.
8) Relations (19) and (20) seem to be a nice fit for understanding weak coupling angle, up and down quark masses and magnetic dipole moments of nucleons.
9) Relations (21) and (22) clearly indicate the best possible astrophysical applications.
10) Relation (23) is a nice fit for understanding planetary and exo-planetary ‘mass dependent’ magnetic dipole moments.
11) Relation (24) indicates a possible relation in between the micro-macro elementary physical constants.

Based on these points, we would like to stress that,

1) In the development of science and engineering, ‘data fitting’ and ‘workability’ are the two essential tools by using which physical models can be generated and validated in a progressive manner.
2) The problem is with ‘our understanding and our perception’ by using which the current ‘scientific standards’ and ‘procedures’ can be reviewed for a better understanding of nature.
3) With reference to String theory models and Quantum gravity models, proposed nuclear gravitational constant and presented results can be given some consideration in developing a ‘workable model’ of ‘scale independent final unification’.
4) Considering the wide applicable range of the proposed assumption, we are confident to say that, with further research and analysis, ‘hidden and left over physics’ can easily be explored.

7. To Synchronize Our Model with String Theory and Electroweak Theory

The basic idea of String theory is very simple, very interesting and highly intuitive. Hence most of the science community strongly believes in String theory and its super child ‘M-theory’. Unfortunately, there are no concrete new predictions of string theories on low energy scales and high energy scale predictions are beyond the reach of current technology. In addition, with string theory, so far, no one could estimate/implement the Newtonian gravitational
constant in nuclear interactions. Many critics of string theory have expressed concerns about the large number of possible solutions and possible universes described by string theory. To sustain the ideology of String theory, to keep its mathematical beauty intact and to make it as a practical model of the nucleus, we would like to emphasize the following two points.

1) String theory was originally introduced for understanding the basic hadronic mass spectrum.

2) By replacing the Newtonian gravitational constant with the proposed strong interaction gravitational constant, original energy levels of String theory can be brought down to the current LHC scale.

Electroweak theory is very important for modern cosmology, particularly on how the universe evolved. This is because shortly after the Big Bang, the temperature was approximately above $10^{15}$ K. Electromagnetic force and weak force were merged into a combined electroweak force. Very interesting feature is that, in our model, we proposed useful relations for fitting and understanding the Fermi’s electroweak coupling constant, weak coupling angle and neutron’s weak decay. Proceeding further, we proposed a very interesting relation for understanding the proton magnetic moment. Extending this relation, we made another bold attempt to fit and understand our earth’s magnetic dipole moment.

8. To Understand the Hadronic Mass Spectrum

In 2010, we published our paper on super symmetry with title “Supersymmetry in strong and weak interactions”. Interested readers may refer [29-34]. The basic concepts were:

1) Fermion – boson mass ratio is very close 2.26.
2) Integral charge quarks exist in bosonic form.
3) Estimated rest energies of up, down and strange quark bosons are, 1.94 MeV, 4.2 MeV and 67.4 MeV respectively.
4) Neutral pion is nothing but the pair of strange quark bosons. Charged pion constitutes neutral pion and down quark boson.
5) Being lighter in mass, up, down and strange quark bosons combine with heavy neutral baryons and generate charged baryons.

In this section, we propose a model mechanism for understanding the hadronic mass spectrum having a neutral charge. Basic idea is that, \( \frac{\hbar c}{G_s} \) can be called as the Nuclear Planck Mass having a neutral charge. It can also be called as the ‘neutral charge nuclear dark baryon’ [9]. Basic hadronic mass spectrum can be understood with the following relation.

\[
\left( m_{\text{baryon}}^2 \right)_n \equiv \left( n \right) ! \left( \frac{1}{\alpha_s} \right)^{\frac{1}{4}} \sqrt{\frac{\hbar c^5}{G_s}} \equiv \left( n \right) ! \left( \frac{1}{\alpha_s} \right)^{\frac{1}{4}} 546.7 \text{ MeV}
\]  
(25)

where \( \alpha_s \) is a strong coupling constant \( \approx 0.115 \) and \( n = 1, 2, 3, 4, \ldots \).

**First generation neutral baryons** can be classified with relation (25). See the following table-2. Sub levels can be approximated with further study and analysis.

| \( n \) | \( \left( m_{\text{baryon}}^2 \right)_n \) MeV |
|---|---|
| 1 | 938.4 |
| 2 | 1116.0 |
| 3 | 1235.0 |
| 4 | 1327.1 |
| 5 | 1403.2 |
| 6 | 1468.7 |

Currently believed Lamda, Delta and Xi baryons seem to fall under first generation baryons. Based on integral charge quark bosons, sigma baryons can be considered as a combination of first generation baryon and up or down or strange quark boson. For example,

- 2\text{nd} level neutral baryon, 1116.0 MeV combines with strange quark boson of rest energy 67.4 MeV and generates a charged baryon of rest energy 1183.4 MeV.
- 4\text{th} level neutral baryon, 1327.1 MeV combines with strange quark boson of rest energy 67.4 MeV and generates a charged baryon of rest energy 1394.5.4 MeV.

In some cases, either a neutral pion or a charged pion also combines with estimated neutral baryon and generates a neutral/charged baryon. The same idea can be applied to second and third generation neutral baryons.

**Second generation neutral baryons** can be estimated with,

\[
\left( m_{\text{baryon}}^2 \right)_n \equiv \left( n \right) ! \left( \frac{1}{\alpha_s} \right)^{\frac{3}{2}} 546.7 \text{ MeV}
\]  
(26)

See the following table-3.

| \( n \) | \( \left( m_{\text{baryon}}^2 \right)_n \) MeV |
|---|---|
| 1 | 1610.7 |
| 2 | 1915.5 |
| 3 | 2119.8 |
| 4 | 2277.9 |
| 5 | 2408.6 |
| 6 | 2520.9 |
Charmed and charmed strange baryons seem to fall under second generation baryons. It is very interesting to note that,

1. Ground state baryon of rest energy 1610.7 MeV seems to combine with strange quark boson of rest energy 67.4 MeV and generates a baryon of rest energy 1678.1 MeV. With respect to mass, this can be compared with currently believed Omega baryon.

2. 2nd level neutral baryon, 1915.5 MeV combines with strange quark boson of rest energy 67.4 MeV and generates a charged baryon of rest energy 1982.9 MeV.

Third generation neutral baryons can be estimated with,

\[ (m_{\text{baryon}}^2)_n \approx \left( n^\frac{1}{2} \left( \frac{1}{\alpha_s} \right) \right) 546.7 \text{ MeV} \quad (27) \]

See the following table-4.

| \( n \) | (\( m_{\text{baryon}}^2 \)) \_n | \( n \) | (\( m_{\text{baryon}}^2 \)) \_n |
|---|---|---|---|
| 1 | 4745.7 | 7 | 7719.2 |
| 2 | 5643.6 | 8 | 7981.2 |
| 3 | 6245.6 | 9 | 8219.7 |
| 4 | 6711.4 | 10 | 8439.1 |
| 5 | 7096.4 | 11 | 8642.6 |
| 6 | 7427.4 | 12 | 8832.7 |

Bottom baryons seem to fall under third generation baryons. Interesting points to be are :

1. Rest energy of ground state baryon of third generation is 4745.7 MeV and its corresponding meson rest energy can be considered as 9490 MeV and can be compared with the first bottom-anti bottom rest energy of 9460 MeV.

2. Second excited level of 4745.7 MeV is 5643.6 MeV. It combines with up, down and strange bosons and generates charged baryons of rest energy 5645.6 MeV, 5647.8 MeV and 5711 MeV. In this way, to some extent charged baryonic mass spectrum can be understood.

First generation neutral mesons can be expressed with,

\[ (m_{\text{meson}}^2)_n \approx \left( n^\frac{1}{2} \left( \frac{1}{\alpha_s} \right) \right) 546.7 \text{ MeV} + 546.7 \text{ MeV} \quad (28) \]

Second generation neutral mesons can be expressed with,

\[ (m_{\text{meson}}^2)_n \approx \left[ \left( n^\frac{1}{2} \left( \frac{1}{\alpha_s} \right) \right) 546.7 \text{ MeV} \right] + 546.7 \text{ MeV} \quad (29) \]

Currently believed and newly reported charmed and charmed strange mesons \([35,36]\) seem to fall under first generation mesons.

See the following table-5.

| \( n \) | (\( m_{\text{meson}}^2 \)) \_n | \( n \) | (\( m_{\text{meson}}^2 \)) \_n |
|---|---|---|---|
| 1 | 1485.1 | 16 | 2423.5 |
| 2 | 1662.7 | 17 | 2452.2 |
| 3 | 1781.7 | 18 | 2479.6 |
| 4 | 1873.8 | 19 | 2505.9 |
| 5 | 1949.9 | 20 | 2531.2 |
| 6 | 2015.4 | 21 | 2555.5 |
| 7 | 2073.1 | 22 | 2579.0 |
| 8 | 2124.9 | 23 | 2601.7 |
| 9 | 2172.1 | 24 | 2623.7 |
| 10 | 2215.4 | 25 | 2645.0 |
| 11 | 2255.7 | 26 | 2665.7 |
| 12 | 2293.3 | 27 | 2685.8 |
| 13 | 2328.6 | 28 | 2705.3 |
| 14 | 2361.9 | 29 | 2724.3 |
| 15 | 2393.5 | 30 | 2742.9 |

Currently believed charmed and anti-charmed mesons and newly discovered and reported exotic mesons seem to fall under second generation mesons.
**Third generation neutral mesons** can be expressed with,
\[
\left( m_{\text{meson}} c^2 \right)_n \cong \left( n \left( \frac{1}{\alpha_c} \right) \frac{1}{\sqrt{2}} \right) 546.7 \text{ MeV}^2 + 546.7 \text{ MeV} \quad (30)
\]

See the following table-7.

**Table 7.** To fit the second generation meson mass spectrum

| \( n \) | \( \left( m_{\text{meson}} c^2 \right)_n \) MeV |
|------|------------------|
| 1    | 5292.4           |
| 2    | 6190.3           |
| 3    | 6792.3           |
| 4    | 7258.1           |
| 5    | 7643.1           |
| 6    | 7974.1           |
| 7    | 8265.9           |
| 8    | 8527.9           |
| 9    | 8766.4           |
| 10   | 8985.8           |

Currently believed most of the bottom mesons, bottom and anti-bottom mesons of rest energy greater than 9490 MeV seem to fall under third generation mesons. By considering the excited levels of 546.7 MeV as \( \frac{1}{\sqrt{2}} \times 546.7 \text{ MeV} \) where \( l = 1, 2, 3, \ldots \) sublevels of all the above mesons can be understood to some extent. For example, 4745.7 MeV baryon can be assumed to couple with \( \frac{1}{\sqrt{2}} \times 546.7 \text{ MeV}, \frac{3}{\sqrt{2}} \times 546.7 \text{ MeV}, \) and \( \frac{4}{\sqrt{2}} \times 546.7 \text{ MeV} \) etc. and generates many sub level mesons. See the following table 8.

**Table 8.** To understand the sub levels of 5292.4 MeV

| \( l \) | \( \left( m_{\text{meson}} c^2 \right)_{(n,l)} \) MeV |
|------|------------------|
| 1    | 5292.4           |
| 2    | 5395.84          |
| 3    | 5465.198         |
| 4    | 5518.851         |
| 5    | 5563.207         |
| 6    | 5601.332         |

Currently believed strange and other light mesons can be understood with the following two relations.

**First relation:**
\[
\left( m_{\text{meson}} c^2 \right)_n \cong \left( n \left( n+1 \right) \left( \frac{1}{\sqrt{2}} \right) \frac{1}{\sqrt{2}} \right) 938.4 \text{ MeV} + 2.26 \quad (31)
\]

where factor 2.26 is an ad hoc factor assumed to be connected with fermion-boson mass ratio pertaining to Super symmetry. It needs in depth analysis at fundamental level. See the following table-9.

**Table 9.** To fit light strange meson mass spectrum with \( \left( \frac{n(n+1)}{2} \right)^{1/4} \)

| \( n \) | \( \left( m_{\text{meson}} c^2 \right)_n \) MeV |
|------|------------------|
| 1    | 493.8            |
| 2    | 649.8            |
| 3    | 722.8            |
| 4    | 778.0            |
| 5    | 797.1            |
| 6    | 1057.0           |

Second relation:
\[
\left( m_{\text{meson}} c^2 \right)_n \cong \left( \frac{n(n+1)}{2} \right) \left( \frac{1}{\sqrt{2}} \right) 415.2 \text{ MeV} \quad (32)
\]

See the following table-10.

**Table 10.** To fit light and strange meson mass spectrum with \( \left( \frac{n(n+1)}{2} \right)^{1/4} \) levels

| \( n \) | \( \left( m_{\text{meson}} c^2 \right)_n \) MeV |
|------|------------------|
| 1    | 415.2            |
| 2    | 546.4            |
| 3    | 649.8            |
| 4    | 738.3            |
| 5    | 817.1            |
| 6    | 888.8            |

Whether, relations (31) and (32) are applicable for all the first generation baryons or applicable only for the ground state of the first generation baryon, is to be decided with further study.

**9. Conclusions**

Subject of final unification is having a long history. So far, no model succeeded in implementing the Newtonian gravitational constant or Planck scale in nuclear and electroweak interactions. Even though, the basic idea of String theory is very simple, very interesting and highly intuitive, there are no concrete new predictions on low energy scales and high energy scale predictions are beyond the reach of current technology. It is an indication of ‘incompleteness’ in String theory paradigm. In this paper, with reference to Planck scale, we presented a variety of relations pertaining to nuclear and electroweak coupling
constants. It is clear from the above discussion that we could satisfactorily fit the nuclear data through empirical relations. This sincere attempt is to be ascertained by the scientific community. We would like to appeal that, with respect to currently believed String theory and Quantum gravity models - proposed assumption, proposed semi empirical relations, proposed procedure for understanding the hadronic mass spectrum, can be given some consideration in developing a ‘workable model’ of TOE.

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