Exploration

The Possible Role of Newtonian, Strong & Electromagnetic Gravitational Constants in Particle Physics

U. V. S. Seshavatharam[1, 2*] & S. Lakshminarayana[3]

[1]Honorary Faculty, I-SERVE, Alakapuri, Hyderabad-35, Telangana, India
[2]ORNNOVA Technologies India Pvt. Ltd, Wilson Gardens, Bangalore-27, India
[3]Department of Nuclear Physics, Andhra University, Visakhapatnam-03, AP, India

Abstract

Considering the earlier suggested gravitational coupling constants assumed to be associated with strong and electromagnetic interactions, we examine in this paper the applicability of the two microscopic gravitational constants in elementary particle physics.With further research and analysis, we are confident that currently believed quark theory can be refined and simplified.

Keywords: Quantum gravity, strong interaction, electromagnetic interaction, Gravitational Constant, Higgs boson, supersymmetry.

1. Introduction

Even though ‘String theory’ models and “quantum gravity’ models [1-10] are having a strong mathematical back ground and sound physical basis, they are failing in implementing the Newtonian gravitational constant [11-16] in atomic,nuclear and particle physics and thus seem to fail in developing a ‘workable’ model of final unification. Considering this failure as a clear inadequacy of ‘current unification paradigm’, we established the existence of two microscopic gravitational coupling constants assumed to be associated with strong and electromagnetic interactions with applications starting from understanding atomic nuclei to neutron star mass and radius. By considering ‘integral charge supersymmetry’, we examine the applicability of the two microscopic gravitational constants in elementary particle physics in this paper.

1. 1 On Strong Gravity

According to W. Lerche [6], “the most dramatic extension of the Standard Model of particle physics that has been proposed so far is string theory. However, as we will discuss in more detail below, string theory too does not provide very concrete answers to the questions posed above. But what string theory does is to provide a resolution of conceptual problems that are on a far deeper level than these “practical” problems. One of the most important problems in modern theoretical physics is the apparent mutual incompatibility of quantum mechanics and general relativity (the theory of gravity) – one theory describing well the world at very short, the other at long distances. Certainly a truly satisfying unified theory should incorporate the gravitational

*Correspondence: Honorary faculty, I-SERVE,Alakapuri,Hyderabad-35,Telangana, India.
E-mail: seshavatharam.uvs@gmail.com

interaction as well, even though traditionally it is not considered as belonging to particle physics".

According to Juan M. Maldacena [7],"we now have a theory, called string theory (or M-theory), which has been able already to provide a solution to the first two challenges. Unfortunately, we do not know yet how to solve the third challenge. Maybe string theory is the solution and we just have to understand it better or maybe we have to modify it in some way. String theory is a theory under construction. We know several limits and aspects of the theory, but we still do not know the fundamental axioms of the theory that would enable us to approach the third challenge" (To Explain the Big Bang and the parameters of the Standard Model).

According to Roberto Onofrio [4], weak interactions are peculiar manifestations of quantum gravity at the Fermi scale, and that the Fermi coupling constant is related to the Newtonian constant of gravitation. In his opinion, at atto-meter scale, Newtonian [17-33] one can see number of papers on 'strong gravity'.It may be noted that, till date, 'strong gravity' is a non-mainstream theoretical approach to Color confinement/particle confinement having both a cosmological scale and a particle scale gravity. In between ~(1960 to 2000), it was taken up as an alternative to the then young QCD theory by several theorists, including Abdus Salam [17]. Very interesting point to be noted is that, Abdus Salam showed that the 'particle level gravity approach' can produce confinement and asymptotic freedom while not requiring a force behavior differing from an inverse-square law, as does QCD.

Many scientists like Abdus Salam, C.Sivaram, K.P.Sinha, E.Racami, T. Zanchin, P.Ammiraju, Hermandez H.E, Kretly L.C, Rodrigues W.A Jr, Antonino Del Popolo, Mario Gambera, K. Tennakone, Usha Raut, V. De Sabbatta, S. I. Fisenko, Igor Fisenko, M. M. Beilinson, B. G. Umanov, P. Caldirola, M. Pavsic, T.R. Momgan, J. Dufour, Sergey Fedosin, Robert Oldershaw, R.A.Stone Jr, Curtis J. Forsy and Nainan K. Varghese etc. seem to believe in 'strong gravity'.

In this paper, we try to combine the old 'strong gravity' concept with 'Newtonian gravity' along with integral charge supersymmetry and finally make an attempt to understand the constructional features elementary particles.

In pursuit of bridging the gap between general theory of relativity and quantum field theory in the earlier publications [34-50], we suggested and validated the role of two gravitational constants associated with strong and electromagnetic interactions and also suggested a supersymmetric fermion-boson mass ratio of 2.26.

1.2 Possible False Failure of Supersymmetry

Supersymmetry [51-56] differs notably from currently known symmetries in that its corresponding conserved charge (via Noether's theorem) is a fermion called a super charge and carrying spin-1/2, as opposed to a scalar (spin-0) or vector (spin-1). A supersymmetry may also be interpreted as new fermionic (anti-commuting) dimensions of space-time, super-partners of the usual bosonic space-time coordinates, and, in this formulation, the theory is said to live in super-space. Currently, there is only indirect evidence for the existence of supersymmetry, primarily in the form of evidence for gauge coupling unification. A central motivation for supersymmetry close to the *TeV* energy scale is the resolution of the hierarchy problem of the Standard Model. Without the extra supersymmetric particles, the Higgs boson mass is subject to quantum corrections which are so large as to naturally drive it close to the Planck mass barring its fine tuning to an extraordinarily tiny value. In supersymmetric theory, on the other hand, these quantum corrections are canceled by those from the corresponding super-partners above the supersymmetry breaking scale, which becomes the new characteristic natural scale for the Higgs mass.

Other attractive features of *TeV*-scale supersymmetry are the fact that it often provides a candidate dark matter particle at a mass scale consistent with thermal relic abundance calculations, provides a natural mechanism for electroweak symmetry breaking and allows for the precise high-energy unification of the weak, the strong and electromagnetic interactions. Therefore, scenarios where supersymmetric partners appear with masses not much greater than 1 *TeV* are considered the well-motivated by theorists. These scenarios would imply that experimental traces of the superpartners should begin to emerge in high-energy collisions at the LHC relatively soon. The Large Hadron Collider at CERN is currently producing the world's highest energy collisions and offers the best chance at discovering super-particles for the foreseeable future.

In a conventional and currently believed modern approach, as of February 2016, no meaningful signs of the super-partners have been observed in LHC. The failure (false failure, in our opinion) of the Large Hadron Collider to find evidence for supersymmetry has led some physicists to suggest that the theory should be abandoned or modified. In this context, we would like to stress the idea that, if one is willing to modify the basic concepts of SUSY, certainly one can recognize and appreciate the great success of LHC already it had in producing super-partners.That is, "confirmation of the success of LHC" depends onhow we perceive, how we analyze and how we interpret the data produced by LHC and problem is not with LHC.In "Supersymmetry in strong and weak interactions" [34], we extended the scopeof supersymmetry to quarks and electroweak interaction. In this paper, we further simplified the procedure and succeededin establishing 'integral charge quark supersymmetry'. It may also be noted that, we could publish our new concepts on'integral charge quark supersymmetry'in2011 DAE-BRNS conference proceedings [35].

1.3Integral Charge Quark Supersymmetry

Until today there is no reason for the question: why there exist6 individual quarks?Until today no experiment reported a 'free quark with fractional charge'. In addition, recently discovered tetra and penta quarks demand changes in basic quark model.Our humble opinion is that nuclear charge (either positive or negative) constitutes 6 different flavors and each flavor holds certain mass. 'Charged flavor' can be called as a 'quark'. It is neither a fermion nor a boson. A 'fermion' is a container for different charges, a 'charge' is a container for different flavors and each 'flavor' is a container for certain 'matter'. If charged matter rests in a 'fermionic container' itis a fermion and if charged matter rests in a 'bosonic container' it is a boson.The fundamental questions to be answered are: What is a charge? Why and how opposite charges attracts each other? Why and how there exists a fermion container? Why and how there exists a boson container?

Here interesting thing is that if6 flavors exist with 6 different masses,then a single chargecanhave one or two ormoreflavors simultaneously.Since charge is a common property, mass of the 'multiple flavor charge' seems to be the harmonic mean of the mass of each flavor. If 'charge with flavor' is called as a 'quark' then 'charge with multi flavors' can be called as a 'hybrid quark'. Hybrid quark generates a multi flavor baryon. It is a property of 'strong interaction space-time'. This is just like 'different tastes' or 'different smells' of matter. Important consequences of this idea are:

1) For each and every quark fermion, there exists a corresponding supersymmetric quark boson.
2) Quark fermion transforms into heavy quark baryon.
3) Quark boson transforms into heavy quark meson.
4) For generating a baryon there is no need to couple 3 fractional charge quarks.
5) For generating a boson there is no need to couple two fractional charge quark fermions.
6) There is no need to consider about 'tetra' and 'penta' quark combinations.

Due to strong interaction there is a chance of coupling any two quark bosons.If any two oppositely charged quark bosons couples together then a neutral quark boson can be generated. It may be called as a neutral meson. Due to strong interaction by any chance if any quark boson couples with any quark fermion then a neutral baryon or baryon with $\pm 2e$ can be generated. This idea is very similar to the 'photon absorption' by electron. When a weakly interacting electron is able to absorb a photon, in strong interaction it is certainly possible. More over if a baryon couples with two or three quark bosons then the baryon mass increases and charge also changes. Here also if the system follows the principle– unlike charges attracts each other – in most of the cases baryon charge changes from $\pm e$ to neutral and neutral to $\pm e$. In rare cases baryon with $\pm 2e$ can be generated.

2. Three Basic Assumptions ofFinal Unification

In ourearlier publications [34-50]we proposed and established the following three assumptions. In the references [34 to 50], one can find many applications starting from atomic nucleus to neutron star covering a wide range of physical phenomena including atomic radii and molar mass constant.

Assumption 1:Magnitude of the gravitational constant associated with the electromagnetic interaction is $G_e \cong (2.375 \pm 0.002) \times 10^{37}\ \mathrm{m^3kg^{-1}sec^{-2}}$.

Assumption 2: Magnitude of the gravitational constant associated with the strong interaction is $G_s \cong (3.328 \pm 0.002) \times 10^{28}\ \mathrm{m^3kg^{-1}sec^{-2}}$.

Assumption 3: Fermion-boson mass ratio is approximately $\Psi \cong 2.255$. This idea can be applied to weakly interacting particles as well as strongly interacting particles.

Note 1:We choose the following semi-empirical relations as 'reference relations' for constructing other semi-empirical relations.

$$\frac{m_p}{m_e} \cong \left(\frac{G_s m_p^2}{\hbar c}\right)\left(\frac{G_e m_e^2}{\hbar c}\right) \text{ and } \left(\frac{G_s m_p m_e}{\hbar c}\right) \cong \left(\frac{\hbar c}{G_e m_e^2}\right) \tag{1}$$

$$m_p \cong \left(\frac{G_N}{G_e}\right)^{\frac{1}{6}}\left(\frac{\hbar c m_e^2}{G_N}\right)^{\frac{1}{4}} \cong \left(\frac{G_N}{G_e}\right)^{\frac{1}{6}}\sqrt{M_{pl} m_e} \tag{2}$$

where $M_{pl} \cong \sqrt{\hbar c / G_N}$ is the Planck mass.

$$\left(\frac{G_e m_e^2}{G_s m_p^2}\right) \approx \left(1 + \ln\left(\frac{m_p}{m_e}\right)\right)^{2.5} \tag{3}$$

Note 2: It may be noted that, with reference to the operating force magnitudes, protons and electrons cannot be considered as 'black holes'. But protons and electrons can be assumed to follow the relations that black holes generally believed to follow. That is, in the study of black holes, Newtonian gravitational constant G_N plays a major role, whereas in the study of elementary particles, G_s and G_e play the key role. For detailed information, see the following section.

3. Understanding the Planck's Constant

Proceeding further, it is possible to show that

$$h \cong \sqrt{\frac{m_p}{m_e}}\sqrt{\left(\frac{G_s m_p^2}{c}\right)\left(\frac{e^2}{4\pi\varepsilon_0 c}\right)} \tag{4}$$

$$hc \cong \sqrt{\frac{m_p}{m_e}}\sqrt{\left(G_s m_p^2\right)\left(\frac{e^2}{4\pi\varepsilon_0}\right)} \tag{5}$$

Note that, these two relations are free from arbitrary coefficients. This is a very strange relation and seems to be connected with quantum theory of radiation. With further research, if one is able to derive these two relations, unification of quantum theory and gravity can be made practical and successful. Based on relation (5) and by considering the recommended values of elementary physical constants [57, 58]

$$\begin{cases} G_s \cong \dfrac{4\pi\varepsilon_0 h^2 c^2 m_e}{e^2 m_p^3} \cong 3.329560807\times10^{28}\ \text{m}^3\text{kg}^{-1}\text{sec}^{-2} \\ G_e \cong \dfrac{\hbar^2 c^2}{G_s m_p m_e^3} \cong \left(\dfrac{\hbar}{h}\right)^2 \left(\dfrac{e^2 m_p^2}{4\pi\varepsilon_0 m_e^4}\right) \cong \left(\dfrac{e^2 m_p^2}{16\pi^3\varepsilon_0 m_e^4}\right) \cong 2.374335471\times10^{37}\ \text{m}^3\text{kg}^{-1}\text{sec}^{-2} \\ G_N \cong \left(\dfrac{m_e}{m_p}\right)^{12} \left(\dfrac{G_s^2 m_p^2}{\hbar c}\right) \cong \left(\dfrac{m_e}{m_p}\right)^{14} \left(\dfrac{4\pi\varepsilon_0}{e^2}\right)^2 \left(\dfrac{2\pi h^3 c^3}{m_p^2}\right) \cong 6.679856051\times10^{-11}\ \text{m}^3\text{kg}^{-1}\text{sec}^{-2} \end{cases} \tag{6}$$

From this data it is very clear to say that, accuracy of G_N seems to depend only on the ratio of $(h/\hbar)$. It is a very important point to be noted here. In the foregoing sections we adopt these unified values.

4. Key Points Pertaining to Final Unification

1) If it is true that c and G_N are fundamental physical constants, then $\left(c^4/G_N\right)$ can be considered as a fundamental compound constant related to a characteristic limiting force [59-62].
2) Black holes are the ultimate state of matter's geometric structure.
3) Magnitude of the operating force at the black hole surface is of the order of $\left(c^4/G_N\right)$.
4) Gravitational interaction taking place at black holes can be called as 'Schwarzschild interaction'.
5) Strength of 'Schwarzschild interaction' can be assumed to be unity.
6) Strength of any other interaction can be defined as the ratio of operating force magnitude and the classical or astrophysical force magnitude $\left(c^4/G_N\right)$.
7) If one is willing to represent the magnitude of the operating force as a fraction of $\left(c^4/G_N\right)$ i.e. X times of $\left(c^4/G_N\right)$, where $X \ll 1$,then

$$\frac{X \text{ times of } \left(c^4/G_N\right)}{\left(c^4/G_N\right)} \cong X \to \text{Effective } G \Rightarrow \frac{G_N}{X} \tag{7}$$

If X is very small, $\frac{1}{X}$ becomes very large. In this way, X can be called as the strength of interaction. Clearly speaking, strength of any interaction is $\frac{1}{X}$ times less than the 'Schwarzschild interaction' and effective G becomes $\frac{G}{X}$.

8) With reference to Schwarzschild interaction, for electromagnetic interaction, $X \approx 2.811\times10^{-48}$ and for strong interaction, $X \cong 2.0\times10^{-39}$.

9) Characteristic operatingforce corresponding to electromagnetic interaction is $\left(c^4/G_e\right) \approx 3.4\times10^{-4}$ N and ccharacteristicoperatingforce corresponding to strong interaction is $\left(c^4/G_s\right) \approx 242600$ N.
10) Characteristic operating power corresponding to electromagnetic interaction is $\left(c^5/G_e\right) \approx 10990$ J/sec and characteristic operating power corresponding to strong interaction is $\left(c^5/G_s\right) \approx 7.27\times10^{13}$ J/sec
11) Based on these concepts, it is possible to assume that,

$$\frac{\left(m_e c^2\right)^{\frac{3}{2}}\left(m_p c^2\right)^{\frac{1}{2}}}{\sqrt{\left(c^4/G_e\right)\left(c^4/G_s\right)}} \cong \hbar c \tag{8}$$

$$\frac{\left(m_e c^2\right)^{\frac{3}{2}}\left(m_p c^2\right)^{\frac{1}{2}}}{\sqrt{\left(c^5/G_e\right)\left(c^5/G_s\right)}} \cong \hbar \tag{9}$$

12) As $\left[\left(c^4/G_e\right),\left(c^4/G_s\right)\right] << \left(c^4/G_N\right)$ and $\left[\left(c^5/G_e\right),\left(c^5/G_s\right)\right] << \left(c^5/G_N\right)$, protons and electrons cannot be considered as ‘black holes’,but may be assumed to follow similar relations that black holes generally believed to follow.
13) According to S.W. Hawking [63], temperature of black hole takes the following expression.

$$T_B \cong \frac{\hbar c^3}{8\pi G_N k_B M_B} \tag{10}$$

where M_B and T_B represent the mass and temperature of a black hole respectively.

According to Abhas Mithra [64,65], currently believed ‘black holes’ area kind of “Eternally Collapsing Objects”. The so-called massive Black Hole Candidates (BHCs) must be quasi-black holes rather than exact black holes and during preceding gravitational collapse, entire mass energy and angular momentum of the collapsing objects must be radiated away before formation of exact mathematical black holes. Abhas Mitra’s peer reviewed papers describe why continued physical gravitational collapse should lead to formation of ECOs rather than true black holes, and the mathematical “black hole” states can be achieved only asymptotically. An ECO is essentiallya quasi-stable ultra-compact ball of fire (plasma) which is so hot due to preceding gravitational contraction that its outward radiation pressure balances its inward pull of gravity. Some astrophysicists claimed to have verified this prediction that astrophysical Black Hole Candidates are actually ECOs rather than true mathematical black holes. One can find relevant information at http://www.cv.nrao.edu/tuna/past/2006/NEW_QSO_STRUCTURE_FOUND.pdf. By considering these two views and by considering the proposed views, melting temperature of elementary particles can be estimated very easily.

From above concepts and relations, melting points of proton and electron can be estimated with the following relations. Melting point of proton,

$$T_{proton} \cong \frac{\hbar c^3}{8\pi k_B G_s m_p} \cong 0.147 \text{ Trillion K} \tag{11}$$

This relation can be applied to quarks also. It may be noted that, RHIC have tentatively claimed to have created a quark–gluon plasma with an approximate temperature of 4 trillion degree Kelvin. A new record breaking temperature was set by ALICE at CERN on August, 2012 in the ranges of 5.5 trillion degree Kelvin. In June 2015, an international team of physicists have produced quark-gluon plasma at the Large Hadron Collider by colliding protons with lead nuclei at high energy inside the supercollider's Compact Muon Solenoid detector at a temperature of 4 trillion degree Kelvin [66-69]. These experimental temperatures are close to the predicted melting temperatures of Proton, up, down and strange quarks and seem to support the proposed pseudo gravitational constantassumed to be associated with strong interaction.

Melting point of electron,

$$T_{electron} \cong \frac{\hbar c^3}{8\pi k_B G_e m_e} \cong 0.3786 \text{ Million K} \tag{12}$$

Melting point of electron is (1/38827) times the melting point of proton. These two estimations are for experimental verification. (Note that, a mistake happened in calculation at relation (32) of our recent publication[50]).

5. Role of the Newtonian Gravitational Constant in Particle Physics

A) Understanding Proton Rest Mass

After so many semi empirical relations,we noticed that,

$$\frac{\sqrt{M_{pl} m_e}}{m_p} \cong \left(\frac{G_e}{G_N}\right)^{\frac{1}{6}} \tag{13}$$

where, $M_{pl} \cong \sqrt{\frac{\hbar c}{G_N}}$. This observation needs experts hands-on experience in decoding its meaning at fundamental level. Based on this relation, if $m_{npl} \cong \sqrt{\frac{\hbar c}{G_s}} \cong 546.6205673 \text{ MeV}/c^2 \cong$ Nuclear Planck mass, it is possible to show that,

$$m_p \cong \left(\frac{G_N}{G_e}\right)^{\frac{1}{6}} \sqrt{M_{pl} m_e} \cong \left(\frac{m_e^6 M_{pl}}{m_{npl}^2}\right)^{\frac{1}{5}} \cong \left(\frac{G_s^2 m_e^{12}}{G_N \hbar c}\right)^{\frac{1}{10}} \cong \left[\left(\frac{G_s}{G_N}\right)\left(\frac{m_e^{12}}{m_{npl}^2}\right)\right]^{\frac{1}{10}} \tag{14}$$

B) Fitting & Understand Muon & Tau Rest Masses

It may be noted that, $\left(\frac{G_e}{G_N}\right)^{\frac{1}{4}} \cong \left(\frac{\sqrt{M_{pl} m_e}}{m_p}\right)^{\frac{3}{2}}$ seems to play a crucial role in fitting muon and tau rest masses in the following way.

$$\left[\gamma^3 + \left(n^2\gamma\right)^n \left(\frac{G_e}{G_N}\right)^{\frac{1}{4}}\right]^{\frac{1}{3}} \sqrt{\frac{e^2 c^4}{4\pi\varepsilon_0 G_e}} \cong \left[\gamma^3 + \left(n^2\gamma\right)^n \left(\frac{G_e}{G_N}\right)^{\frac{1}{4}}\right]^{\frac{1}{3}} 0.00175 \text{ MeV} \tag{15}$$

$\gamma \cong \sqrt{\frac{4\pi\varepsilon_0 G_e m_e^2}{e^2}} \cong 292.2328$ and $n \cong 1, 2$. Obtained masses of muon and tau are106.54 MeV and 1781.54 MeV and can be compared with the respective experimental values of 105. 66 MeV and 1776.86 MeV [57].

C) Fitting & Understanding the Characteristic Charged Lepton

It may be noted that, recent galactic X-ray [70-74] studies strongly confirm the existence of a new photon of energy 3.5 keV. Its origin is unknown and scientists guess that, it is a decay product of 7 keV sterile neutrino. In this context, we would like to suggest the following alternative mechanism for understanding the origin of 3.5 keV the photon.

1)There exists a charged lepton of rest mass,

$$\left(m_{xl}\right)^{\pm} \cong \sqrt{\frac{e_e^2}{4\pi\varepsilon_0 G_e}} \cong 1.75 \text{ keV}/c^2 \tag{16}$$

2) $\left(m_{xl}\right) \approx 1.75 \text{ keV}/c^2$ plays a vital role in generating the observed charged leptons.
3)With pair annihilation mechanism, $\left(m_{xl}\right)$ generates a photon of rest energy 3.5keV
4)With current and future particle accelerators $\left(m_{xl}\right)^{\pm} \cong 1.75 \text{ keV}/c^2$ can be generated.

D) Fitting the weak coupling angle

Weak coupling angle can be definedas follows [57].

$$\sin\theta_W \cong \sqrt{\frac{4\pi\varepsilon_0 G_s m_p m_e}{e^2}} \cong 0.4689276 \tag{17}$$

$$\sin^2\theta_W \cong \left(\frac{4\pi\varepsilon_0 G_s m_p m_e}{e^2}\right) \tag{18}$$

E) Understanding the strong coupling constant

We define the strong coupling constant as follows.

$$\begin{aligned} \frac{1}{\alpha_s} &\cong \exp\sqrt{\frac{e^2}{4\pi\varepsilon_0 G_s m_p m_e}} \cong 8.436146 \\ \rightarrow \alpha_s &\cong \left\{\exp\sqrt{\frac{e^2}{4\pi\varepsilon_0 G_s m_p m_e}}\right\}^{-1} \cong 0.11853754 \end{aligned} \tag{19}$$

F) Relation betweenweak coupling angle and strong coupling constant

$$\sin\theta_W \cong \left[\ln\left(\frac{1}{\alpha_s}\right)\right]^{-1} \cong 0.4689276 \tag{20}$$

$$\sin^2\theta_W \cong \left[\ln\left(\frac{1}{\alpha_s}\right)\right]^{-2} \cong 0.21989305 \tag{21}$$

G) Understanding the weakly interacting boson

We define that

$$\frac{m_{Xf}c^2}{m_{pf}c^2} \cong \frac{m_{Xb}c^2}{m_{pb}c^2} \cong \ln\left(\frac{G_e}{G_N}\right) \cong 109.5 \tag{22}$$

where m_{Xf} is the assumed mass of characteristic weakly interacting fermion and m_{pf} is the rest mass of proton.

m_{Xb} is the assumed mass of characteristic weakly interacting boson and m_{pb} is the rest mass of proton in bosonic form.

Thus, in fermionic form,

$$m_{Xf}c^2 \cong \ln\left(\frac{G_e}{G_N}\right)m_{pf}c^2$$
$$\cong 109.4897\times 938.272 \text{ MeV} \cong 102731.12 \approx 102731.0 \text{ MeV} \tag{23}$$

With reference to Supersymmetry and Higgs physics, this characteristic charged fermion can be called as the 'charged SUSY Higgs fermion'. With reference to electroweak theory [57], we noticed that,

$$\frac{m_{Xf}c^2}{\sin\theta_W \cos\theta_W} \cong 248.04 \text{ GeV} \approx 246.22 \text{ GeV} \tag{24}$$

In bosonic form,

$$m_{Xb}c^2 \cong \ln\left(\frac{G_e}{G_N}\right)\left(\frac{m_{pf}c^2}{\Psi}\right)$$
$$\cong 109.4897\times\left(\frac{938.272}{2.255}\right)\text{MeV} \tag{25}$$
$$\cong 109.5\times(416.085)\text{MeV} \cong 45557.04 \text{ MeV} \approx 45557.0 \text{ MeV}$$

With reference to Supersymmetry and Higgs physics, this characteristic charged boson can be called as the 'charged Higgs SUSY boson'.

Note 3: These two proposed mass units play a key role in estimating the quark baryon and quark meson rest masses. In our earlier publication, we proposed two susy mass units as 11450 MeV and 5060 MeV. In this paper, with reference to electroweak interaction and Higgs concept of mass generation, considering $\left(\frac{\sin\theta_W}{2}\right)$ as a proportionality ratio, we try to modify them as 102731 MeVand 45557 MeV respectively.

Note 4: Very interesting and exciting observation is that, quark mesonic mass of 45557 MeV is 10681MeV and can be compared with recently discoveredcharged meson [75].

H) Understanding the weakly interacting neutral Zboson

It can be interpreted as the mass summation of positive $m_{Xb}c^2$ and negative $m_{Xb}c^2$.

$$m_Zc^2 \cong \left(m_{Xb}c^2\right)^+ + \left(m_{Xb}c^2\right)^-$$
$$\cong 2\times 45557 \text{ MeV} \cong 91114 \text{ MeV} \tag{26}$$

I) Understanding the weakly interacting charged Wboson

From electro weak theory [57],

$$m_W c^2 \cong \cos\theta_W m_Z c^2 \cong 80475.22 \text{ MeV} \approx 80475.0 \text{ MeV}$$
$$\text{where } \cos\theta_W \cong 0.8832366 \tag{27}$$

J) Understanding the newly discovered Higgs boson of rest energy 126 GeV

It is noticed that [57],

$$m_H c^2 \cong \left(m_{Xb}c^2\right)^{\pm} + \left(m_W c^2\right)^{\mp} \cong 45557.0 + 80475.0 \cong 126032.0 \text{ MeV} \tag{28}$$

6. Understanding Baryon & Meson Mass Spectrum

This proposed model differs from current model of quark theory in many ways. See the following table1. Important points to be noted are:

A) There exist integral charge quark fermions and integral charge quark bosons.

B) Integral charge quark fermions transform into integral charge quark baryons.

C) Integral charge quark bosons transform into integral charge quark mesons.

D) All the observed baryons including the currently believed exotic penta quarks [76] of charge $\pm e$ can be understood as two flavor quark baryons having charge $\pm e$.

E) Observed baryonic doublets and triplets can be understood as combinations oftwo flavor quark baryons coupled with light quark bosons like u_b = 1.91 MeV/ c^2, d_b=4.1 MeV/ c^2 and s_b=66.5 MeV/ c^2 .

F) Ground and excited quark mesons couple with light quark bosons like u_b = 1.91 MeV/ c^2, d_b=4.1 MeV/ c^2 and s_b=66.5 MeV/ c^2generating ground and excited light neutral mesons.

G) Ground or exited quark mesons couple with other quark mesons generating heavy neutral mesons. With this idea recently discovered heavy tetra quark mesons[77-80] can be understood very easily.

H) Currently believed neutral pion constitutes a pair of strange bosons generating a mass of $2s_b$=133.0 MeV/ c^2.

I) Currently believed charged pion can be considered as a combination of neutral pion and one d_b=4.1 MeV/c^2generating a mass of 137.0 MeV/c^2.

J) Excited charged baryons and charged mesons can be shown to be following a relation of $n^{1/4}$ where $n = 1, 2, 3, ..$

K) Currently believed charged W boson is very close to the top quark boson. It is for further research and discussion.

L) Currently believed bottom and anti-bottom mesons can be considered as the combination of second generation bottomand anti-bottom mesons only.

M) Currently believed tetra quark charged mesons can be considered as the second generation bottom-strange mesons.

Table 1. Comparative study on standard quark model and modified integral charge SUSYquark model

S.No	Standard quark model	Proposed model
1	There exist only 6 quarks supposed to have fermionic behavior with fractional charge	There exist6 quark fermions as well as 6 quark bosons having charge $\pm e$.
2	A. Priority is given to 'fractional charges'. B. Particle selection is based on 'fractional charge'	A. Priority is given to integral charge B. 'Combination of quark flavors' play a key role rather than 'physical coupling of quark fermions'
3	Three quarks couple together to form any observable baryon	A. Physically there exists only one massive quark (quark baryon) with 2 quark flavors. B. By any reason, any two quark baryons couple together, energy can be generated by charge annihilation. C. Light quark boson couples with quark baryons and generates doublets and triplets. This is similar to 'absorption of electrons by atom'.
4	Two quarks couple together to form any observable meson	Physically there exists only one heavy quark boson (quark meson) with two or three quark flavors.
5	Understanding and predicting the masses of penta quarks and tetra quarks is very complicated	Understandingand predicting the masses heavy baryons and heavy mesons is very easy.
6	No clear cut explanation is available for understanding the heaviness of proton mass compared to the sum of two up and one down quarkrest masses	Proton rest mass can be fitted and understood with the harmonic mean of up quark baryon rest massand down quark baryon rest mass.
7	Complicated mass relations	Up, strange and bottom quarks are in one geometric series and Down, charm and top quarks are in another geometric series
8	Classification scheme is based on particle charge, particle mass and particle decay scheme.	Classification scheme is based on particle charge, particle mass and quark flavors
9	No definition is available for weak coupling angle $(\sin\theta_W)$ in terms of quark masses	Ratio of up quark mass and down quark mass can be considered as the magnitude of the weak coupling angle $(\sin\theta_W)$.
10	No relation is available between strong coupling constant and up and down quark masses	1. Down and up quark mass ratio can be considered as the natural logarithm of inverse of the strong coupling constant. 2. Ratio of electron rest mass and up quark rest mass can be considered as

		the strong coupling constant
11	There is no clear explanation for neutron-proton mass difference	Neutron-proton mass difference can be fitted with $\sin^2\theta_W$ times the harmonic mean of up and down quark fermion rest masses.
12	Existence of 8 quark gluons	No need of quark gluons. Quark bosons transforms to heavy quark mesons.
13	Failed in understanding super symmetry	Introduces super symmetry
14	Involved with complicated mathematics	Simple mathematics
15	Theoretical model	Phenomenological model

7. Estimating the Quark Mass

A) Estimate the masses of up and down quarks

We define that,

$$\frac{d_f c^2}{u_f c^2} \cong \frac{d_b c^2}{u_b c^2} \cong \ln\left(\frac{1}{\alpha_s}\right) \cong \sqrt{\frac{e^2}{4\pi\varepsilon_0 G_s m_p m_e}} \cong 2.132526 \cong K....(say) \tag{29}$$

d_f is the assumed rest mass of down quark fermion and u_f is the assumed rest mass of up quark fermion.

$d_b \cong (d_f/\Psi)$ is the assumed rest mass of down quark boson and $u_b \cong (u_f/\Psi)$ is the assumed rest mass of up quark boson. Clearly speaking,

$$\frac{\text{Down quark fermion mass}}{\text{Up quark fermion mass}} \cong \frac{\text{Down quark boson mass}}{\text{Up quark boson mass}} \cong \ln\left(\frac{1}{\alpha_s}\right) \tag{30}$$

$$\frac{u_f c^2}{m_{ef} c^2} \cong \left(\frac{1}{\alpha_s}\right) \cong \exp\sqrt{\frac{e^2}{4\pi\varepsilon_0 G_s m_p m_e}} \tag{31}$$

where m_{ef} is the rest mass of electron in fermion form and $m_{eb} \cong (m_{ef}/\Psi)$ is the rest mass of electron in bosonic form. Clearly speaking,

$$\begin{cases} \dfrac{\text{Up quark fermion mass}}{\text{Electron mass}} \cong \left(\dfrac{1}{\alpha_s}\right) \cong \exp\sqrt{\dfrac{e^2}{4\pi\varepsilon_0 G_s m_p m_e}} \\ \dfrac{\text{Electron mass}}{\text{Up quark fermion mass}} \cong \alpha_s \cong \left\{\exp\sqrt{\dfrac{e^2}{4\pi\varepsilon_0 G_s m_p m_e}}\right\}^{-1} \end{cases} \tag{32}$$

$$u_f c^2 \cong \left(\frac{1}{\alpha_s}\right) m_{ef} c^2 \cong K * m_{ef} c^2 \cong 4.31\text{ MeV} \tag{33}$$

$$\begin{aligned} u_b c^2 &\cong \frac{u_f c^2}{\Psi} \cong \left(\frac{1}{\alpha_s}\right)\left(\frac{m_{ef} c^2}{\Psi}\right) \\ &\cong K\left(\frac{m_{ef} c^2}{\Psi}\right) \cong k\left(m_{eb} c^2\right) \cong 1.91\text{ MeV} \end{aligned} \tag{34}$$

$$\begin{aligned} d_f c^2 &\cong \ln\left(\frac{1}{\alpha_s}\right) u_f c^2 \cong \ln(K)\left(u_f c^2\right) \cong 9.20\text{ MeV} \\ d_b c^2 &\cong \ln\left(\frac{1}{\alpha_s}\right) u_b c^2 \cong \ln(K)\left(u_b c^2\right) \cong 4.08\text{ MeV} \end{aligned} \tag{35}$$

It may be noted that, proposed up and down quark fermion rest masses are roughly two times the recommended values [34,57].

B) Fitting & Understandingthe mass difference of neutron and proton

Neutron-proton mass difference can be fitted with the following relation.

$$\begin{aligned} \left(m_n - m_p\right) c^2 &\cong \left(\frac{u_f}{d_f}\right)^2 \left[\frac{2 u_f d_f}{\left(u_f + d_f\right)}\right] \cong 1.291\text{ MeV} \\ &\cong 0.494\left[\frac{2 u_b d_b}{\left(u_b + d_b\right)}\right] \approx \frac{1}{2}\left[\frac{2 u_b d_b}{\left(u_b + d_b\right)}\right] \end{aligned} \tag{36}$$

C) Estimating the masses of strange and bottom quarks

We define that, up, strange and bottom quarks are geometric series and their geometric ratio can be expressed in the following form.

$$g_{usb} \cong \left(K\left(\frac{K+1}{K-1}\right)\right)^2 \cong 34.79 \tag{37}$$

Thus, in fermionic form, strange and bottom quark fermion masses can be estimated in the following way

$$\begin{aligned} s_f c^2 &\cong 34.79 \times 4.313 \text{ MeV} \cong 149.95 \approx 150.0 \text{ MeV} \\ b_f c^2 &\cong (34.79)^2 \times 4.31 \text{ MeV} \cong 5217.2 \approx 5217.0 \text{ MeV} \end{aligned} \tag{38}$$

In bosonic form, strange and bottom quark boson masses can be estimated in the following way

$$\begin{aligned} s_b c^2 &\cong 34.79 \times 1.91 \text{ MeV} \cong 66.45 \approx 66.5 \text{ MeV} \\ b_b c^2 &\cong (34.76)^2 \times 1.91 \text{ MeV} \cong 2312.05 \approx 2312.0 \text{ MeV} \end{aligned} \tag{39}$$

D) Estimate the masses of charmand top quarks

We define that, down, charm and top quarks are geometric series and their geometric ratio can be expressed in the following form.

$$g_{dct} \cong \left(2K\left(\frac{K+1}{K-1}\right)\right)^2 \cong 139.17 \tag{40}$$

Thus, in fermionic form, charm and top quark fermion masses can be estimated in the following way

$$\begin{aligned} c_f c^2 &\cong 139.17 \times 9.20 \text{ MeV} \cong 1280.35 \approx 1280.0 \text{ MeV} \\ t_f c^2 &\cong (139.17)^2 \times 9.20 \text{ MeV} \cong 178185.05 \approx 178185.0 \text{ MeV} \end{aligned} \tag{41}$$

In bosonic form, charm and topquark boson masses can be estimated in the following way

$$\begin{aligned} c_b c^2 &\cong 139.15 \times 4.08 \text{ MeV} \cong 567.81 \approx 568.0 \text{ MeV} \\ t_b c^2 &\cong (139.17)^2 \times 4.08 \text{ MeV} \cong 79021.2 \approx 79021.0 \text{ MeV} \end{aligned} \tag{42}$$

$$\frac{\text{Down quark series geometric ratio}}{\text{Up quark series geometric ratio}} \cong 4 \tag{43}$$

8. Estimating the Masses of Quark Baryons

Quark baryonmass can be defined in the following way.

$$\begin{aligned} Q_B c^2 &\cong \frac{1}{2K}\left[\left(m_{Xf} c^2\right)^2 \left(m_{Qf} c^2\right)\right]^{\frac{1}{3}} \\ &\cong \frac{\sin\theta_W}{2}\left[\left(m_{Xf} c^2\right)^2 \left(m_{Qf} c^2\right)\right]^{\frac{1}{3}} \end{aligned} \tag{44}$$

where, Q_B is the quark baryon mass, Q_f is the corresponding quark fermion mass and m_{Xf} is the proposed characteristic weakly interacting fermion of rest energy 102731 MeV. See the following table-2 for quark fermion and quark baryon rest energies.

Table 2. Quark baryon masses

Quark	Quark fermion rest energy $m_{Qf}c^2$ MeV	Quark baryon rest energy Q_Bc^2 MeV
Up	4.31	837.0
Down	9.20	1078.0
Strange	150.5	2736.0
Charm	1280.0	5584.0
Bottom	5217.0	8920.0
Top	178185.0	28940.0

9. Estimating the Masses of Quark Mesons

Quark meson mass can be defined in the following way.

$$\begin{aligned} Q_M c^2 &\cong \frac{1}{2K}\left[\left(m_{Xb}c^2\right)^2\left(m_{Qb}c^2\right)\right]^{\frac{1}{3}} \\ &\cong \frac{\sin\theta_W}{2}\left[\left(m_{Xb}c^2\right)^2\left(m_{Qb}c^2\right)\right]^{\frac{1}{3}} \end{aligned} \tag{45}$$

where, Q_M is the quark meson mass, Q_b is the corresponding quark boson mass and m_{Xb} is the proposed characteristic weakly interacting boson of rest energy 45557 MeV. See the following table-3 for quark boson and quark meson rest energies.

Table 3. Quark gluon masses

Quark	Quark boson rest energy $m_{Qb}c^2$ MeV	Quark meson rest energy Q_Mc^2 MeV
Up	1.91	371.0
Down	4.08	478.0
Strange	66.5	1212.0
Charm	568.0	2477.0
Bottom	2312.0	3955.0
Top	79021.0	12834.0

10.Ground State Baryon Mass Spectrum

With reference to previous section, one may expect 15 ground state baryons in the following way.

1) ud ground state baryon having charge $\pm e$

$$(ud)_B \cong \frac{2u_B d_B}{u_B + d_B} \approx 942.0 \text{ MeV}/c^2$$

2) su ground state baryon having charge $\pm e$

$$(su)_B \cong \frac{2s_B u_B}{s_B + u_B} \approx 1282.0 \text{ MeV}/c^2$$

3) sd ground state baryon having charge $\pm e$

$$(sd)_B \cong \frac{2s_B d_B}{s_B + d_B} \approx 1547.0/c^2$$

4) cuground state baryon having charge $\pm e$

$$(cu)_B \cong \frac{2c_B u_B}{c_B + u_B} \approx 1456.0 \text{ MeV}/c^2$$

5) cdground state baryon having charge $\pm e$

$$(cd)_B \cong \frac{2c_B d_B}{c_B + d_B} \approx 1807.0 \text{ MeV}/c^2$$

6) cs ground state baryon having charge $\pm e$

$$(cs)_B \cong \frac{2c_B s_B}{c_B + s_B} \approx 3673.0 \text{ MeV}/c^2$$

7) bu ground state baryon having charge $\pm e$

$$(bu)_B \cong \frac{2b_B u_B}{b_B + u_B} \approx 1530.0 \text{ MeV}/c^2$$

8) bd ground state baryon having charge $\pm e$

$$(bd)_B \cong \frac{2b_B d_B}{b_B + d_B} \approx 1924.0 \text{ MeV}/c^2$$

9) bs ground state baryon having charge $\pm e$

$$(bs)_B \cong \frac{2b_B s_B}{b_B + s_B} \approx 4188.0 \text{ MeV}/c^2$$

10) bc ground state baryon having charge $\pm e$

$$(bc)_B \cong \frac{2b_B c_B}{b_B + c_B} \approx 6868.0 \text{ MeV/}c^2$$

11) tu ground state baryon having charge $\pm e$

$$(tu)_B \cong \frac{2t_B u_B}{t_B + u_B} \approx 1627.0 \text{ MeV/}c^2$$

12) tdground state baryon having charge $\pm e$

$$(td)_B \cong \frac{2t_B d_B}{t_B + d_B} \approx 2079.0 \text{ MeV/}c^2$$

13) ts ground state baryon having charge $\pm e$

$$(ts)_B \cong \frac{2t_B s_B}{t_B + s_B} \approx 4999.0 \text{ MeV/}c^2$$

14) tc ground state baryon

$$(tc)_B \cong \frac{2t_B c_B}{t_B + c_B} \approx 9362 \text{ MeV/}c^2$$

15) tb ground state baryon having charge $\pm e$

$$(tb)_B \cong \frac{2t_B b_B}{t_B + b_B} \approx 13637 \text{ MeV/}c^2$$

10.1 Excitedbaryon mass spectrum

Excited charged baryon levels can be expressed in the following way.

$$\begin{aligned} &(Baryon)_{\text{excited}} \cong n^{\frac{1}{4}} (Baryon)_{\text{ground}} \\ &\text{where, } n = 1, 2, 3, \ldots \end{aligned} \tag{46}$$

See table-4 for the charged baryon mass spectrum starting from (u,d) baryons to (bs) baryons. This proposalis almost similar to Regge trajectory of mesons or baryons.See the following table-4 for the excited quark baryon levels.

Table 4: Ground and excited baryon levels having charge $\pm e$

n	$n^{\frac{1}{4}}$	$(ud)_B^{\pm e}$ levels	$(su)_B^{\pm e}$ levels	$(sd)_B^{\pm e}$ levels	$(cu)_B^{\pm e}$ levels	$(cd)_B$ levels	$(cs)_B^{\pm e}$ levels	$(bu)_B^{\pm e}$ levels	$(bd)_B^{\pm e}$ levels	$(bs)_B^{\pm e}$ levels	$(bc)_B^{\pm e}$ levels
1	1	942	1282	1547	1456	1807	3673	1530	1924	4188	6868
2	1.1892071	1120	1525	1840	1731	2149	4368	1819	2288	4980	8167
3	1.316074	1240	1687	2036	1916	2378	4834	2014	2532	5512	9039
4	1.4142136	1332	1813	2188	2059	2555	5194	2164	2721	5923	9713
5	1.4953488	1409	1917	2313	2177	2702	5492	2288	2877	6263	10270
6	1.5650846	1474	2006	2421	2279	2828	5749	2395	3011	6555	10749
7	1.6265766	1532	2085	2516	2368	2939	5974	2489	3130	6812	11171
8	1.6817928	1584	2156	2602	2449	3039	6177	2573	3236	7043	11551
9	1.7320508	1632	2220	2679	2522	3130	6362	2650	3332	7254	11896
10	1.7782794	1675	2280	2751	2589	3213	6532	2721	3421	7447	12213
11	1.8211603	1716	2335	2817	2652	3291	6689	2786	3504	7627	12508
12	1.8612097	1753	2386	2879	2710	3363	6836	2848	3581	7795	12783
13	1.8988289	1789	2434	2937	2765	3431	6974	2905	3653	7952	13041
14	1.9343364	1822	2480	2992	2816	3495	7105	2960	3722	8101	13285
15	1.9679897	1854	2523	3044	2865	3556	7228	3011	3786	8242	13516

10.2 Baryon Doublets & Triplets

Ground or excited baryons couple with light quark bosons like up boson of mass 1.91 MeV/c^2, down quark boson of mass 4.08 MeV/c^2 and strange quark boson of mass 66.5 MeV/c^2 and generates neutral as well as charged baryons.Considering the data presented in table-3 and table-1, a variety of neutral baryons can be generated. In general, ground and excited state charged baryons seem to couple with 1.91 MeV, 4.08 MeV and 66.5 MeV light quark bosons and generate neutral ground and excited state baryons.

For example,

A) $(ud)_B^{\pm e}$ baryons and $\left\{\left[\text{excited } (ud)_B^{\pm e}\right]+(u_b, d_b, s_b)\right\}$ can be compared with Lambda, sigma and Xi baryons. See the following table 5. Data accuracy can be improved by considering proton mass as the ground state mass.

B) $(su)_B^{\pm e}$ baryons and $\left\{\left[\text{excited } (su)_B^{\pm e}\right]+(u_b, d_b, s_b)\right\}$ can be compared with Omega baryons.

C) $(bu)_B^{\pm e}$ baryons and $\left\{\left[\text{excited } (bu)_B^{\pm e}\right]+(u_b, d_b, s_b)\right\}$ can be compared with currently believed charmed baryons.

See the following table 5 for ground and excited Lambda, Delta, Sigma and Xi baryons.

Table 5. Ground and excited Lambda, Delta, Sigma and Xi baryons

n	$n^{\frac{1}{4}}$	$(ud)_B^{\pm e}$ levels	$(ud)_B^{\pm e}$ levels $+u_b^{\mp e}$	$(ud)_B^{\pm e}$ levels $+d_b^{\mp e}$	$(ud)_B^{\pm e}$ levels $+s_b^{\mp e}$
1	1	942	944	946	1009
2	1.1892071	1120.2331	1122	1124	1187
3	1.316074	1239.7417	1242	1244	1306
4	1.4142136	1332.1892	1334	1336	1399
5	1.4953488	1408.6186	1411	1413	1475
6	1.5650846	1474.3097	1476	1478	1541
7	1.6265766	1532.2352	1534	1536	1599
8	1.6817928	1584.2488	1586	1588	1651
9	1.7320508	1631.5919	1634	1636	1698
10	1.7782794	1675.1392	1677	1679	1742
11	1.8211603	1715.533	1717	1720	1782
12	1.8612097	1753.2595	1755	1757	1820

10.3 Fitting & Understanding Penta Quarks

It may be noted that, recently particle physicists guess about the existence of penta quarks. In this context, 1530 MeV, 4380 MeV and 4450 MeV believed to be penta quarks.1530 MeV can be considered as theground state level of $(bu)_B^{\pm e}$. Similarly, 4380 MeV can be considered as the 2nd excited level of $(cs)_B^{\pm e}$. With further analysis, back ground physics of currently believed penta quarks can be understood in avery simple and unified approach.

11.Understanding Meson Mass Spectrum

Point to be noted is that, all the observed medium and heavy mesons are composed of quark mesons only.

Various compound quark mesons having charge e can be expressed in the following way.

1) ud meson having charge $\pm e$

$$(ud)_M \cong \frac{2u_M d_M}{u_M + d_M} \approx 418.0 \text{ MeV}/c^2$$

2) su meson having charge $\pm e$

$$(su)_M \cong \frac{2s_M u_M}{s_M + u_M} \approx 568.0 \text{ MeV}/c^2$$

3) sd meson having charge $\pm e$

$$(sd)_M \cong \frac{2s_M d_M}{s_M + d_M} \approx 686.0 \text{ MeV}/c^2$$

4) cu meson having charge $\pm e$

$$(cu)_M \cong \frac{2c_M u_M}{c_M + u_M} \approx 645.0 \text{ MeV}/c^2$$

5) cd meson having charge $\pm e$

$$(cd)_M \cong \frac{2c_M d_M}{c_M + d_M} \approx 801.0 \text{ MeV}/c^2$$

6) cs meson having charge $\pm e$

$$(cs)_M \cong \frac{2c_M s_M}{c_M + s_M} \approx 1628.0 \text{ MeV}/c^2$$

7) bu meson having charge $\pm e$

$$(bu)_M \cong \frac{2b_M u_M}{b_M + u_M} \approx 678.0 \text{ MeV}/c^2$$

8) bd meson having charge $\pm e$

$$(bd)_M \cong \frac{2b_M d_M}{b_M + d_M} \approx 853.0 \text{ MeV}/c^2$$

9) bs meson having charge $\pm e$

$$(bs)_M \cong \frac{2b_M s_M}{b_M + s_M} \approx 1855.0 \text{ MeV}/c^2$$

10) bc meson having charge $\pm e$

$$(bc)_M \cong \frac{2b_M c_M}{b_M + c_M} \approx 3046.0 \text{ MeV}/c^2$$

11) tu meson having charge $\pm e$

$$(tu)_M \cong \frac{2\, t_M u_M}{t_M + u_M} \approx 721.0 \text{ MeV}/c^2$$

12) td meson having charge $\pm e$

$$(td)_M \cong \frac{2\, t_M d_M}{t_M + d_M} \approx 922.0 \text{ MeV}/c^2$$

13) ts meson having charge $\pm e$

$$(ts)_M \cong \frac{2\, t_M s_M}{t_M + s_M} \approx 2215.0 \text{ MeV}/c^2$$

14) tc meson having charge $\pm e$

$$(tc)_M \cong \frac{2\, t_M c_M}{t_M + c_M} \approx 4153.0 \text{ MeV}/c^2$$

15) tb meson having charge $\pm e$

$$(tb)_M \cong \frac{2\, t_M b_M}{t_M + b_M} \approx 6047.0 \text{ MeV}/c^2$$

Any two mesons out of 6 basic quark mesons and 15 compound quark mesons generate the observed neutral mesons.

For example, see the following table 6 for the estimated neutral up mesons to bottom mesons. In addition, currently believed tetra neutral tetra quark meson massescan also be fitted.

Table 6. Estimated neutral up mesons to bottom mesons

$d_M + u_M \approx 849.0$ MeV	$c_M + (u)_M \approx 2848.0$ MeV	$(bs)_M + (u)_M \approx 2226.0$ MeV
$(ud)_M + u_M \approx 789.0$ MeV	$c_M + (ud)_M \approx 2895.0$ MeV	$(bs)_M + (ud)_M \approx 2273.0$ MeV
$(ud)_M + d_M \approx 896.0$ MeV	$c_M + (d)_M \approx 2955.0$ MeV	$(bs)_M + (d)_M \approx 2333.0$ MeV
$(su)_M + u_M \approx 939.0$ MeV	$c_M + (su)_M \approx 3045.0$ MeV	$(bs)_M + (su)_M \approx 2423.0$ MeV
$(su)_M + d_M \approx 1046.0$ MeV	$c_M + (sd)_M \approx 3163.0$ MeV	$(bs)_M + (sd)_M \approx 2541.0$ MeV
$(su)_M + (ud)_M \approx 986.0$ MeV	$c_M + (cu)_M \approx 3122.0$ MeV	$(bs)_M + (cu)_M \approx 2500.0$ MeV
$(cu)_M + (u)_M \approx 1016.0$ MeV	$c_M + (cd)_M \approx 3278.0$ MeV	$(bs)_M + (cd)_M \approx 2656.0$ MeV
$(cu)_M + (d)_M \approx 1123.0$ MeV	$c_M + (s)_M \approx 3689.0$ MeV	$(bs)_M + (cs)_M \approx 3483.0$ MeV
$(cu)_M + (ud)_M \approx 1063.0$ MeV	$c_M + (cs)_M \approx 4105.0$ MeV	$(bs)_M + (bu)_M \approx 2533.0$ MeV
$s_M + (u)_M \approx 1583.0$ MeV	$c_M + (bu)_M \approx 3155.0$ MeV	$(bs)_M + (bd)_M \approx 2708.0$ MeV
$s_M + (ud)_M \approx 1630.0$ MeV	$c_M + (bs)_M \approx 4332.0$ MeV	$(bs)_M + (bs)_M \approx 3710.0$ MeV
$s_M + (d)_M \approx 1690.0$ MeV	$c_M + c_M \approx 4954.0$ MeV	
$s_M + s_M \approx 2424.0$ MeV		
$(cs)_M + (u)_M \approx 1999.0$ MeV	$(bc)_M + (d)_M \approx 3524.0$ MeV	$b_M + (d)_M \approx 4433.0$ MeV
$(cs)_M + (ud)_M \approx 2046.0$ MeV	$(bc)_M + (su)_M \approx 3614.0$ MeV	$b_M + (su)_M \approx 4523.0$ MeV
$(cs)_M + (d)_M \approx 2106.0$ MeV	$(bc)_M + (sd)_M \approx 3732.0$ MeV	$b_M + (sd)_M \approx 4641.0$ MeV
$(cs)_M + (su)_M \approx 2196.0$ MeV	$(bc)_M + (cu)_M \approx 3691.0$ MeV	$b_M + (cu)_M \approx 4600.0$ MeV
$(cs)_M + (sd)_M \approx 2314.0$ MeV	$(bs)_M + (cd)_M \approx 3847.0$ MeV	$b_M + (cd)_M \approx 4756.0$ MeV

$(cs)_M + (cu)_M \approx 2273.0$ MeV	$(bc)_M + (cs)_M \approx 4674.0$ MeV	$b_M + (cs)_M \approx 5583.0$ MeV
$(cs)_M + (cd)_M \approx 2429.0$ MeV	$(bc)_M + (bu)_M \approx 3724.0$ MeV	$b_M + (bu)_M \approx 4633.0$ MeV
$(cs)_M + (cs)_M \approx 3256.0$ MeV	$(bc)_M + (bd)_M \approx 3899.0$ MeV	$b_M + (bd)_M \approx 4808.0$ MeV
$(bc)_M + (bu)_M \approx 3724.0$ MeV	$(bc)_M + (bs)_M \approx 4901.0$ MeV	$b_M + (bs)_M \approx 5810.0$ MeV
$(bc)_M + (bc)_M \approx 6092.0$ MeV	$(bc)_M + (bc)_M \approx 6092.0$ MeV	$b_M + (bc)_M \approx 7001.0$ MeV
$(bc)_M + (u)_M \approx 3417.0$ MeV	$b_M + (u)_M \approx 4326.0$MeV	$b_M + s_M \approx 5167.0$ MeV
$(bc)_M + (ud)_M \approx 3464.0$ MeV	$b_M + (ud)_M \approx 4373.0$ MeV	$b_M + c_M \approx 6432.0$ MeV
		$b_M + b_M \approx 7902.0$ MeV

See the following table 7 for neutral top mesons.

Table 7. Estimated neutral up mesons to bottom mesons

$(ts)_M + (u)_M \approx 2586.0$ MeV	$(tc)_M + (u)_M \approx 4524.0$ MeV	$(tb)_M + (u)_M \approx 6418.0$ MeV
$(ts)_M + (ud)_M \approx 2633.0$ MeV	$(tc)_M + (ud)_M \approx 4571.0$ MeV	$(tb)_M + (ud)_M \approx 6465.0$ MeV
$(ts)_M + (d)_M \approx 2693.0$ MeV	$(tc)_M + (d)_M \approx 4631.0$ MeV	$(tb)_M + (d)_M \approx 6525.0$ MeV
$(ts)_M + (su)_M \approx 2783.0$ MeV	$(tc)_M + (su)_M \approx 4721.0$ MeV	$(tb)_M + (su)_M \approx 6615.0$ MeV
$(ts)_M + (sd)_M \approx 2901.0$ MeV	$(tc)_M + (sd)_M \approx 4839.0$ MeV	$(tb)_M + (sd)_M \approx 6733.0$ MeV
$(ts)_M + (cu)_M \approx 2860.0$ MeV	$(tc)_M + (cu)_M \approx 4798.0$ MeV	$(tb)_M + (cu)_M \approx 6692.0$ MeV
$(ts)_M + (cd)_M \approx 3016.0$ MeV	$(tc)_M + (cd)_M \approx 4954.0$ MeV	$(tb)_M + (cd)_M \approx 6848.0$ MeV
$(ts)_M + (cs)_M \approx 3843.0$ MeV	$(tc)_M + (cs)_M \approx 5781.0$ MeV	$(tb)_M + (cs)_M \approx 7675.0$ MeV
$(ts)_M + (bu)_M \approx 2893.0$ MeV	$(tc)_M + (c)_M \approx 6627.0$ MeV	$(tb)_M + (c)_M \approx 8524.0$ MeV
$(ts)_M + (bd)_M \approx 3068.0$ MeV	$(tc)_M + (bu)_M \approx 4831.0$ MeV	$(tb)_M + (bu)_M \approx 6725.0$ MeV
$(ts)_M + (tu)_M \approx 2936.0$ MeV	$(tc)_M + (c)_M \approx 6627.0$ MeV	$(tb)_M + (bd)_M \approx 6900.0$ MeV
$(ts)_M + (td)_M \approx 3137.0$ MeV	$(tc)_M + (bs)_M \approx 6008.0$ MeV	$(bc)_M + (bs)_M \approx 7902.0$ MeV
$(ts)_M + (ts)_M \approx 4430.0$ MeV	$(tc)_M + (bc)_M \approx 7199.0$ MeV	$(tb)_M + (bc)_M \approx 9093.0$ MeV
	$(tc)_M + (b)_M \approx 8108.0$ MeV	$(tb)_M + (tu)_M \approx 6768.0$ MeV
	$(tc)_M + (tu)_M \approx 4874.0$ MeV	$(tb)_M + (td)_M \approx 6969.0$ MeV
	$(tc)_M + (td)_M \approx 5075.0$ MeV	$(tb)_M + (ts)_M \approx 8262.0$ MeV
	$(tc)_M + (ts)_M \approx 6368.0$ MeV	$(tb)_M + (tc)_M \approx 10200.0$ MeV

11.1 Excitedmeson mass spectrum

Excited charged mesons levels can be expressed in the following way.

$$\begin{aligned}&(Meson)_{\text{excited}} \cong n^{\frac{1}{4}}(Meson)_{\text{ground}}\\&\text{where, } n = 1,2,3,...\end{aligned} \tag{47}$$

See the following table 8 for ground and excited charged mesons.

Table 8. Ground and excited meson levels having charge $\pm e$

n	$n^{\frac{1}{4}}$	$(ud)_M^{\pm e}$ levels	$(su)_M^{\pm e}$ levels	$(sd)_M^{\pm e}$ levels	$(cu)_M^{\pm e}$ levels	$(cd)_M$ levels	$(cs)_M^{\pm e}$ levels	$(bu)_M^{\pm e}$ levels	$(bd)_M^{\pm e}$ levels	$(bs)_M^{\pm e}$ levels	$(bc)_M^{\pm e}$ levels
1	1	418	568	686	645	801	1628	678	853	1855	3046
2	1.1892071	497	675	816	767	953	1936	806	1014	2206	3622
3	1.316074	550	748	903	849	1054	2143	892	1123	2441	4009
4	1.4142136	591	803	970	912	1133	2302	959	1206	2623	4308
5	1.4953488	625	849	1026	964	1198	2434	1014	1276	2774	4555
6	1.5650846	654	889	1074	1009	1254	2548	1061	1335	2903	4767
7	1.6265766	680	924	1116	1049	1303	2648	1103	1387	3017	4955
8	1.6817928	703	955	1154	1085	1347	2738	1140	1435	3120	5123
9	1.7320508	724	984	1188	1117	1387	2820	1174	1477	3213	5276
10	1.7782794	743	1010	1220	1147	1424	2895	1206	1517	3299	5417
11	1.8211603	761	1034	1249	1175	1459	2965	1235	1553	3378	5547
12	1.8612097	778	1057	1277	1200	1491	3030	1262	1588	3453	5669
13	1.8988289	794	1079	1303	1225	1521	3091	1287	1620	3522	5784
14	1.9343364	809	1099	1327	1248	1549	3149	1311	1650	3588	5892
15	1.9679897	823	1118	1350	1269	1576	3204	1334	1679	3651	5994

Points to be noted:

1) Ground or excited quark mesons couple with light quark bosons like up boson of mass 1.91 MeV/c^2, down quark boson of mass 4.08 MeV/c^2 and strange quark boson of mass 66.5 MeV/c^2 and generate light neutral mesons.
2) Currently believed mesons like 497 and 547 MeV can be understood with excited $(ud)_M^{\pm e}$ levels. See thefollowing table 9.
3) Currently believedother light mesons can be understood with excited $(ud)_M^{\pm e}$, $(su)_M^{\pm e}$, $(sd)_M^{\pm e}$ and $(cu)_M^{\pm e}$, $(cd)_M^{\pm e}$ levels.
4) Currently believedcharmed meson of rest energy 1869 MeV can be compared with ground sate $(bs)_M^{\pm e}$ level of 1855 MeV. Similarly, currently believedcharmed meson of rest energy 2460 MeV can be compared with3rdexcited level of $(bs)_M^{\pm e}$ level of 2441 MeV.

5) Currently believedcharged charm-strange mesons can be understood with $(cs)_M^{\pm e}$ levels. For example 1968 MeV can be compared with estimated 1936 MeV. 2112 MeV can be compared with estimated 2143 MeV, 2317 MeV can be compared with 2302 MeV, 2460 MeV can be compared with 2434 MeV, 2536 can be compared with 2548 MeV and 2709 can be compared with 2768 MeV.

6) Currently believedbottom mesons, bottom strangemesons, bottom charm mesons can be understood with $(bc)_M^{\pm e}$ levels.

11.2 Ground & Excited Neutral Kaons

Currently believed strange mesons like 497 MeV, 547 MeVcan be considered as the excited levels of meson $(ud)_M^{\pm e}$ of rest energy 418 MeV. Excited levels couple with up quark boson and down quark boson and generate neutral mesons

Table 9. Ground and excited levels of $(ud)_M^{\pm e}$

n	$n^{\frac{1}{4}}$	$(ud)_M^{\pm e}$ levels	$(ud)_M^{\pm e}$ level+ $u_b^{\mp}$	$(ud)_M^{\pm e}$ level+ $d_b^{\mp}$
1	1	418	420	422
2	1.1892071	497	499	501
3	1.316074	550	552	554
4	1.4142136	591	593	595
5	1.4953488	625	627	629
6	1.5650846	654	656	658
7	1.6265766	680	682	684
8	1.6817928	703	705	707
9	1.7320508	724	726	728
10	1.7782794	743	745	747
11	1.8211603	761	763	765
12	1.8612097	778	780	782

In this table 9, at n=2, estimated 497 MeV can be compared with charged 493 MeV kaon. Neutral 499MeV or neutral 501 MeV can be compared with neutral kaon of rest energy 497 MeV.

11.3 Currently Believed Bottom-anti Bottom Mesons

The following points can be given some consideration in understanding the currently believed bottom-anti-bottom mesons.

1. Charged bottom meson transforms to second generation bottom meson with the following relation.

$$b_{M2}c^2 \cong \frac{1}{2k}\left[\left(m_{Xf}c^2\right)^2\left(b_{M1}c^2\right)\right]^{\frac{1}{3}} \\ \cong \frac{\sin\theta_W}{2}\left[\left(45557\right)^2\left(3955\right)\right]^{\frac{1}{3}} \cong 4730 \text{ MeV} \quad (48)$$

where b_{M2} can be called as second generation bottom meson and b_{M1} can be called as first generation bottom meson.

2. Excited levels of $(b)_{M2}$ can be estimated as follows.

$$\left(b_{M2}\right)_n c^2 \cong \frac{\sin\theta_W}{2}\left[\left(45557\right)^2\left(n^{\frac{1}{4}}3955\right)\right]^{\frac{1}{3}} \cong n^{\frac{1}{12}} * 4730 \text{ MeV} \quad (49)$$

3. n^th^ excited state couples with oppositely chargedn, (n-1), (n-2), (n-3),.. excited states and generates *n*number of neutral mesons.See the following table -10.

Table 10. Ground and excited levels of $(b)^{\pm e}_{M2}$

n	$n^{\frac{1}{12}}$	$(b)^{\pm e}_{M2}$ levels
1	1	4730
2	1.059463	5011
3	1.095873	5183
4	1.122462	5309
5	1.14353	5409
6	1.161037	5492
7	1.176047	5563
8	1.189207	5625
9	1.200937	5680
10	1.211528	5731

4. At n=1,9460 MeV can be generated
5. At n=2, 9741 MeV and 10022 MeV can be generated.
6. At n=3, 9913 MeV,10194 MeV and 10366 MeV can be generated.
7. At n=4, 10039 MeV,10320 MeV,10492 MeV and 10618 MeV can be generated.
8. At n=5, 10139 MeV,10420 MeV,10592 MeV, 10718 and 10818 MeV can be generated.
9. At n=6, 10222 MeV,10503 MeV,10675 MeV, 10801MeV, 10901 MeV and 10984 MeV can be generated.

11.4 Fitting & Understanding the Currently Believed Tetra Quark Mesons

Currently believed charged tetra mesons 3900 MeV, 4050 MeV, 4250 MeV,4430 MeV etc. can be fitted in the following way.

1. Charged bottomstrange meson transforms to second generation bottom strange meson with the following relation.

$$\begin{aligned}(bs)_{M2}c^2 &\cong \frac{1}{2K}\left[\left(m_{Xf}c^2\right)^2\left((bs)_{M1}c^2\right)\right]^{\frac{1}{3}} \\ &\cong \frac{\sin\theta_W}{2}\left[(45557)^2(1855)\right]^{\frac{1}{3}} \approx 3675 \text{ MeV}\end{aligned} \quad (50)$$

where $(bs)_{M2}$ can be called as second generation bs meson and $(bs)_{M1}$ can be called as first generation bs meson.

2. Charged excited levels of $(bs)_{M2}$ can be estimated as follows.

$$\left((bs)_{M2}\right)_n c^2 \cong \frac{\sin\theta_W}{2}\left[(45557)^2\left(n^{\frac{1}{4}}3675\right)\right]^{\frac{1}{3}} \cong n^{\frac{1}{12}} * 3675 \text{ MeV} \quad (51)$$

See the following table 11.

Table 11. To fit and understand the currently believed tetra quark charged mesons

n	$n^{\frac{1}{4}}$	$(bs)_{M2}^{\pm e}$ levels
1	1	3675
2	1.0594631	3894
3	1.0958727	4027
4	1.122462	4125
5	1.1435298	4202
6	1.1610367	4267
7	1.1760474	4322
8	1.1892071	4370
9	1.200937	4413
10	1.2115277	4452

3. With further research and analysis, other predicted levels can be discovered.

12.Conclusion

With strong gravity concepts and supersymmetry, we proposed in this paper several unified concepts, relations and data fitting procedures for understanding the observed nuclear elementary particles and predicted several new particle levels. With further research and analysis,we are confident that currently believed quark theory can be refined and simplified.

Acknowledgements: Author U.V.S. Seshavatharam is indebted to professor K. V. Krishna Murthy, Chairman, Institute of Scientific Research on Vedas (I-SERVE), Hyderabad, India and Shri K. V. R. S. Murthy, former scientist IICT (CSIR) Govt. of India, Director, Research and Development, I-SERVE, for their valuable guidance and great support in developing this subject.

Received March 01, 2016; Accepted March 15, 2016

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