To unify the string theory and the strong gravity

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Abstract

Key conceptual link that connects the gravitational force and non-gravitational forces is - the classical force limit, $F_C \cong \left(\frac{c^4}{G}\right)$. It can be considered as the upper limit of the cosmic string tension. Weak force magnitude F_W can be considered as the characteristic nuclear weak string tension. In 3+1 dimensions if strong interaction is really 10^{39} times stronger than the strength of gravity, until the measurement of $(F_C \ \& \ F_W)-$ it can be assumed that $\frac{F_C}{F_W} \cong N^2$ where N is Avogadro like number.

Keywords: classical force limit; weak force magnitude; (effective) atomic gravitational constant; nuclear and atomic radii; charged leptons; dark matter; nucleons; nuclear stability; nuclear binding energy constants; weak coupling angle; strong coupling constant; quark masses ;

1 Introduction

Considering strong gravity, Erasmo Recami says [1]: *A consequence of what stated above is that inside a hadron (i.e., when we want to describe strong interactions among hadron constituents) it must be possible to adopt the same Einstein equations which are used for the description of gravitational interactions inside our cosmos; with the only warning of scaling them down, that is, of suitably scaling, together with space distances and time durations, also the gravitational constant G (or the masses) and the cosmological constant* Λ. In 3+1 dimensions, experiments and observations reveals that, if strength of strong interaction is unity, with reference to the strong interaction, strength of gravitation is 10^{-39}. Alternatively, strong interaction is 10^{39} times stronger than the strength of gravity. If this is true, any model or theory must explain this astounding fact. At least in 10 dimensions also, till today no model including String theory [2-4] or Super gravity [5,6] has succeeded in explaining this fact. Note that in the atomic or nuclear physics, till today no experiment reported or estimated the value of the gravitational constant. It is sure that something is missing in the current understanding of unification. This clearly indicates the need of revision of our existing physics foundations. In this sensitive and critical situation, considering (squared) Avogadro like a large number as an absolute proportionality ratio in this paper an attempt is made to understand the basics of gravitational and non-gravitational interactions in a unified manner.

1.1 Basic questions and a move from string theory to strong gravity

In unification success of any model depends on how the gravitational constant is implemented in atomic, nuclear and particle physics. David Gross [7] says: *But string theory is still in the process of development, and although it has produced many surprises and lessons it still has not broken dramatically with the conceptual framework of relativistic quantum field theory. Many of us believe that ultimately string theory will give rise to a revolution in physics, as important as the two revolutions that took place in the 20th century, relativity and quantum mechanics. These revolutions are associated with two of the three fundamental dimensionful parameters of nature, the velocity of light and Plancks constant.* ***The revolution in string theory presumably has to do with Newton's constant, that defines a length, the Planck length of*** 10^{-33} ***cm***. *String theory, I believe, will ultimately modify in a fundamental way our concepts at distances of order this length.*

In this connection the fundamental questions to be answered are: What is the 'physical base' for extra dimensions and their compactification? Why the assumed 10 dimensional compactification is ending at the observed (3+1) dimensions? During the dimensional compactification: 1) How to confirm that that there is no variation in the magnitude of the observed (3+1 dimensional) physical constant or physical property? 2) if space-time is curled up to the least possible (planck) size, how to interpret or understand the observed (3+1 dimensional) nuclear size and atomic sizes which are very large compared to the tiny planck size?

The concept of 'extra dimension' is very interesting but at the same time one must see its 'real existence' and 'workability' in the real physical world. Kaluza and Klein [8] showed that if one assumed general relativity in five dimensions, where one dimension was curled up, the resulting theory would look like a four-dimensional theory of electromagnetism and gravity. When gravity is existing in 3+1 dimensions, what is the need of assuming it in 5 dimensions? In the reality of (4+1) dimensional laboratory, how to confirm that, (3+1) dimensional gravity will not change in (4+1) dimensions? When gravity and electromagnetism both are existing in 3+1 dimensions, unifying them within 5 dimensions seems to be very interesting but impracticable. More over to unify 2 interactions if 5 dimensions are required, for unifying 4 interactions 10 dimensions are required. For 3+1 dimensions if there exists 4 (observed) interactions, for 10 dimensions there may exist 10 (observable) interactions. To unify 10 interactions 20 dimensions are required. From this idea it can be suggested that- with 'n' new dimensions 'unification' problem can not be resolved.

Erasmo Recami says [1]: *Let us recall that Riemann, as well as Clifford and later Einstein, believed that the fundamental particles of matter were the perceptible evidence of a strong local space curvature. A theory which stresses the role of space (or, rather, space-time) curvature already does exist for our whole cosmos: General Relativity, based on Einstein gravitational field equations; which are probably the most important equations of classical physical theories, together with Maxwell's electromagnetic field equations. Whilst much effort has already been made to generalize Maxwell equations, passing for example from the electromagnetic field to Yang-Mills fields (so that almost all modern gauge theories are modelled on Maxwell equations), on the contrary Einstein equations have never been applied to domains different from the gravitational one. Even if they, as any differential equations,* *do not contain any inbuilt fundamental length: so that they can be used a priori to describe cosmoses of any size. Our first purpose is now to explore how far it is possible to apply successfully the methods of general relativity (GR), besides to the world of gravitational interactions, also to the domain of the so-called nuclear, or strong, interactions: namely, to the world of the elementary particles called hadrons. A second purpose is linked to the fact that the standard theory (QCD) of strong interactions has not yet fully explained why the hadron constituents (quarks) seem to be permanently confined in the interior of those particles; in the sense that nobody has seen up to now an isolated "free" quark, outside a hadron. So that, to explain that confinement, it has been necessary to invoke phenomenological models, such us the so-called "bag" models, in their MIT and SLAC versions for instance. The "confinement" could be explained, on the contrary, in a natural way and on the basis of a well-grounded theory like GR, if we associated with each hadron (proton, neutron, pion,...) a particular "cosmological model".*

1.2 Significance of large number ratios in unification

In his large number hypothesis P. A. M. Dirac [9, 10] compared the ratio of characteristic size of the universe and classical radius of electron with the electromagnetic and gravitational force ratio of electron and proton. If the cosmic closure density is, $\rho_0 \cong \frac{3H_0^2}{8\pi G}$, number of nucleons in a Euclidean sphere of radius $\left(\frac{c}{H_0}\right)$ is equal to $\frac{c}{H_0} \div \frac{2Gm_n}{c^2}$. It can be suggested that coincidence of large number ratios reflects an intrinsic property of nature.

It can be supposed that elementary particles construction is much more fundamental than the black hole's construction. If one wishes to unify electroweak, strong and gravitational interactions it is a must to implement the classical gravitational constant G in the sub atomic physics [11-13]. By any reason if one implements the planck scale in elementary particle physics and nuclear physics automatically G comes into subatomic physics. Then a large 'arbitrary number' has to be considered as a proportionality constant. With this large arbitrary number it is be possible to understand the mystery of the strong interaction and strength of gravitation. Any how, the subject under consideration is very sensitive to human thoughts, experiments and observations. In this critical situation here let us consider the valuable words of Einstein: *'The successful attempt to derive delicate laws of nature, along a purely mental path, by following a belief in the formal unity of the structure of reality, encourages continuation in this speculative direction, the dangers of which everyone vividly must keep in sight who dares follow it'.*

2 The two key assumptions in unification

2.0.1 Assumption-1

The key conceptual link that connects the gravitational and non-gravitational forces is - the classical force limit

$$F_C \cong \left(\frac{c^4}{G}\right) \cong 1.21026 \times 10^{44}\text{newton} \tag{1}$$

It can be considered as the upper limit of the string tension. In its inverse form it appears in Einstein's theory of gravitation [1] as $\frac{8\pi G}{c^4}$. It is having multiple applications in Black hole physics and Planck scale physics [14,15].

2.0.2 Assumption-2

Ratio of 'classical force limit = F_C' and 'weak force magnitude = F_W, ' is N^2 where N is a large number close to the Avogadro number.

$$\frac{F_C}{F_W} \cong N^2 \cong \frac{\text{Cosmic string tension}}{\text{nuclear weak string tension}} \tag{2}$$

2.0.3 Points to be considered

1. Upper limit of the classical force or upper limit of the string tension is $\frac{c^4}{G}$. It has to be measured either from the experiments or from the cosmic and astronomical observations.

2. The weak force magnitude is $\frac{c^4}{N^2 G}$ where N is a large number whose magnitude is close to the Avogadro number. It can be considered as the characteristic nuclear weak string tension. It can be measured in the particle accelerators.

3. The definition of N^2 is more intrinsic than the definition of existing Avogadro number. By measuring the magnitudes of F_C and F_W, N^2 and N can be obtained. Until their measurement one can not decide whether it is the Avogadro number or not. In 3+1 dimensions if strong interaction is really 10^{39} times stronger than the strength of gravity, this new definition of Avogadro like number can be given a chance in unification program.

4. To proceed further in this paper for calculation purpose squared Avogadro number $= \left(6.022141793 \times 10^{23}\right)^2$ is considered as the characteristic ratio of F_C and F_W. In this attempt it is noticed that either in SI system of units or in CGS system of units, value of the order of magnitude of Avogadro like number is close to 6×10^{23} but not 6×10^{26}.

5. Equations (6,8,10,13,20,22,23,27,29,32,39 and 43 to 71) clearly shows the applications of the proposed assumptions in different ways.

2.1 The characteristic atomic 'coulomb mass' and the atomic 'planck mass'

For N number of particles, if effective strength of gravity is $(N.G)$, any one particle's weak binding force magnitude can be defined as

$$F_W \cong \frac{1}{N} \cdot \left(\frac{c^4}{N.G}\right) \cong \frac{c^4}{N^2 G} \cong 3.33715 \times 10^{-4} \text{ newton} \tag{3}$$

It can be considered as the characteristic leptonic or nuclear or weak 'string tension'. It can also be considered as the 'weak force magnitude'. Similar to the classical force limit assumed weak force magnitude can be defined as

$$F_W \cong \frac{c^4}{G_A} \cong 3.33715 \times 10^{-4} \text{ newton} \tag{4}$$

Then in atomic or nuclear physics, whether it is imaginary or effective or real,

$$G_A \cong \left(\frac{F_C}{F_W}\right) G \cong N^2 G \tag{5}$$

can be called as the atomic gravitational constant. If it is working like a single physical constant as the gravitational constant, then it can be considered as the real atomic gravitational constant. Magnitude of $G_A \cong N^2 G = 2.420509614 \times 10^{37}\ \text{m}^3\text{kg}^{-1}\text{sec}^{-2}$. With reference to the above relations it is possible to define two new mass units. They are atomic 'coulomb mass' and atomic 'planck mass'. Atomic coulomb mass can be expressed as

$$m_C \cong \sqrt{\frac{e^2}{4\pi\epsilon_0 \left(N^2 G\right)}} \cong \sqrt{\frac{e^2}{4\pi\epsilon_0 \left(G_A\right)}} \cong 3.087291597 \times 10^{-33}\ Kg \tag{6}$$

$$E_W \cong m_C c^2 \cong \sqrt{\frac{e^2 c^4}{4\pi\epsilon_0 \left(N^2 G\right)}} \cong \sqrt{\frac{e^2}{4\pi\epsilon_0}\left(\frac{c^4}{G_A}\right)} \cong 1.731843735\ KeV \tag{7}$$

Similar to the Planck mass, 'Atomic planck mass' can be represented as

$$m_P \cong \sqrt{\frac{\hbar c}{\left(N^2 G\right)}} \cong \sqrt{\frac{\hbar c}{G_A}} \cong 3.614056909 \times 10^{-32}\ Kg. \tag{8}$$

$$E_P \cong m_P c^2 \cong \sqrt{\frac{\hbar c^5}{\left(N^2 G\right)}} \cong \sqrt{\hbar c \left(\frac{c^4}{G_A}\right)} \cong 20.27337431\ KeV \tag{9}$$

These two strange mass units play a very interesting role in nuclear and particle physics. E_W can be defined as the 'characteristic weak energy constant'. It can also be considered as the characteristic 'dark matter' or 'dark energy' constant . This may be the beginning of 'strong nuclear gravity' [16-22].

In strong (nuclear) gravity, the strong or atomic gravitational constant is the supposed physical constant of strong gravitation, involved in the calculation of the gravitational attraction at the level of elementary particles and atoms. The idea of strong gravity originally referred specifically to mathematical approach of Abdus Salam of unification of gravity and quantum chromo-dynamics, but is now often used for any particle level gravity approach. In literature one can refer the works of Abdus Salam, C. Sivaram, Sabbata, A. H. Chamseddine, J. Strathdee, Usha Raut, K. P. Sinha, J. J. Perng, E. Recami, R. L. Oldershaw, K. Tennakone, S. I Fisenko and S. G. Fedosion. In 3+1 dimensions if strong interaction is really 10^{39} times stronger than the strength of gravity, proposed new definition of Avogadro number can be given a chance in unification program. With reference to super symmetry it can be termed as 'Super atomic gravity.' Authors proposed interesting concepts [23-30] in this new direction.

2.2 The characteristic dark matter unit

Conceptually these two mass units m_C and m_P can be compared with the characteristic building block of the 'charged' or 'neutral' dark matter [31]. Note that either in cosmology or particle physics till today there is no clear cut mechanism for understanding the massive origin of the dark matter. 1.732 KeV is very close the neutrino mass. The fundamental question to be answered is: Is 1.732 KeV a potential or a charged massive particle? If it is a particle its pair annihilation leads to radiation energy. If it is the base particle in elementary particle physics - observed particle rest masses can be fitted. Authors humble opinion is: it can be considered as the basic charged lepton or lepton potential. It can also be considered as the basic charged 'dark matter' candidate.

2.3 Mystery of the gram mole

If $M_P \cong \sqrt{\frac{\hbar c}{G}}$ is the Planck mass and m_e is the rest mass of electron, semi empirically it is observed that,

$$M_g \cong N^{-\frac{1}{3}} \cdot \sqrt{(N \cdot M_P)\,(N \cdot m_e)} \cong 1.0044118 \times 10^{-3}\ Kg \tag{10}$$

$$M_g \cong N^{\frac{2}{3}} \cdot \sqrt{M_P m_e} \tag{11}$$

Here M_g is just crossing the mass of one gram. If m_p is the rest mass of proton,

$$\frac{M_g}{m_p} \cong N \cong 6.003258583 \times 10^{23} \tag{12}$$

$$\frac{\sqrt{M_P m_e}}{m_p} \cong N^{\frac{1}{3}} \tag{13}$$

More accurate empirical relation is

$$\frac{\sqrt{M_P m_e}\ c^2}{\frac{m_p c^2 + m_n c^2 - B_a}{2} + m_e c^2} \cong N^{\frac{1}{3}} \tag{14}$$

where m_n is the rest mass of neutron, and $B_a \cong 8$ MeV is the mean binding eneregy of nucleon. Obtained value of $N \cong 6.020215677 \times 10^{23}$. The unified atomic mass-energy unit $m_u c^2$ can be expressed as

$$m_u c^2 \cong \left(\frac{m_p c^2 + m_n c^2}{2} - B_a\right) + m_e c^2 \cong 931.4296786 \text{ MeV} \tag{15}$$

Corresponding unified atomic mass unit is $m_u \cong 1.660424068 \times 10^{-27}$ Kg. The electroechemical equivalent z of any element can be given as

$$z \cong \frac{A \cdot m_u}{v \cdot e} \cong \frac{\text{atomic mass of the element}}{v \cdot e} \tag{16}$$

where v = valence number, A = atomic mass number and e = elementary charge. Thus Farady's first law of electrolysis can be expressed as

$$M_d \cong z \cdot i \cdot t \cong \left(\frac{i \cdot t}{v \cdot e}\right) A \cdot m_u \cong \left(\frac{i \cdot t}{v \cdot e}\right) \cdot \text{atomic mass of the element} \tag{17}$$

where M_d is the mass of the deposited element, i is the current and t is the current passage time.

2.4 Squared Avogadro like number in unification

In SI system of units why gram mole is being used? This fundamental question can be answered if it is assumed that there exists a limit for the quantum mechanical atomic mass. The definition of 'quantum mechanical atomic mass' can be given as- it is the upper limit for the mass of an elementary particle or mass of a microscopic system or mass of an atom where in the existing quantum mechanical and atomic laws can be applied. If mass of the system crosses the limit, quantum mechanics and atomic structure transforms to classical physical laws. Quantitatively the assumed mass limit can be obtained in the following way.

$$G_A m_p^2 \cong G M_g^2 \tag{18}$$

$$\left(\frac{M_g}{m_p}\right)^2 \cong N^2 \cong \frac{G_A}{G} \tag{19}$$

where m_p = operating mass unit in atomic physics $\cong$ mass of proton, M_g = operating mass unit in classical physics, G_A is the atomic gravitational constant and G the classical gravitational constant.

Hence $M_g \cong N \times m_p \cong 1.0072466 \times 10^{-3}\ Kg \cong 1.0072466$ gram. In this way gram mole can be understood. Semi empirically it is also noticed that

$$\ln \sqrt{\frac{e^2}{4\pi\varepsilon_0 G m_P^2}} \cong \sqrt{\frac{m_p}{m_e} - \ln\left(N^2\right)} \tag{20}$$

where m_p is the proton rest mass and m_e is the electron rest mass. From this expression

$$G \cong \left(e^{\sqrt{\frac{m_p}{m_e} - \ln(N^2)}}\right)^{-2} \cdot \frac{e^2}{4\pi\varepsilon_0 m_P^2} \cong 6.666270179 \times 10^{-11}\ \text{m}^3\text{Kg}^{-1}\text{sec}^{-2}. \tag{21}$$

These are very simple and strange observations. But their interpretation seems to be a big puzzle in fundamental physics.

3 Bohr radius and the mystery of $n\hbar$

David Gross [7] says: *After sometime in the late 1920s Einstein became more and more isolated from the mainstream of fundamental physics. To a large extent this was due to his attitude towards quantum mechanics, the field to which he had made so many revolutionary contributions. Einstein, who understood better than most the implications of the emerging interpretations of quantum mechanics, could never accept it as a final theory of physics. He had no doubt that it worked, that it was a successful interim theory of physics, but he was convinced that it would be eventually replaced by a deeper, deterministic theory. His main hope in this regard seems to have been the hope that by demanding singularity free solutions of the nonlinear equations of general relativity one would get an overdetermined system of equations that would lead to quantization conditions.* These words clearly suggests that, at fundamental level there exists some interconnection in between quantum mechanics and gravity. If $G_A \cong N^2 G$ surprisingly it is noticed that

$$\hbar \cong \frac{1}{2}\sqrt{\left(\frac{e^2}{4\pi\varepsilon_0 c}\right) \cdot \left(\frac{G_A m_e^2}{c}\right)} \cong 1.135 \times 10^{-34}\ \text{j.sec} \approx 1.05457 \times 10^{-34}\ \text{j.sec} \tag{22}$$

This may be a coincidence also. From this expression existence of the atomic gravitational constant can be confirmed directly. If it is really true, this may be considered as the beginning of unified quantum mechanics. From accuracy point of view here factor $\frac{1}{2}$ can be replaced with the weak mixing angle $\sin\theta_W$. From the quantum nature of elementary charge, quantum nature of $\hbar$ can be understood.

If $R_0 \cong 1.2$ fm is the minimum distance between any 2 nucelons [32], then size of the nucleon is close to $\frac{R_0}{2} \cong 0.6$ fm. Bohr radius in Hydrogen atom seems to be close to

$$a_0 \cong \left(\frac{4\pi\varepsilon_0 G_A m_e^2}{e^2}\right) \cdot \left(\frac{R_0}{2}\right) \tag{23}$$

Here $\frac{e^2}{4\pi\varepsilon_0 G_A m_e^2}$ is nothing but the electromagnetic and gravitational force ratio of electron where the operating gravitational constant is $G_A \cong N^2 G$. Comparing this relation with the Bohr's first assumption, it is noticed that

$$\hbar \cong \sqrt{\frac{G_A m_e^3 R_0}{2}} \cong \sqrt{G_A m_e^3 \left(\frac{R_0}{2}\right)} \tag{24}$$

How to interpret this strange equation? If electron is revolving round the nucleus, natuarally R_0 seems to be the characteristic physical input and $\hbar$ seems to be the characteristic out put. Equation (22) shows the possibility of considering $\hbar$ as a secondary physical constant. Considering the integral nature of N i.e N, $2N$, $3N$,... the quantum nature of angular momentum takes the following form.

$$n \cdot \hbar \cong (n \cdot N) \sqrt{G m_e^3 \left(\frac{R_0}{2}\right)} \quad \text{n} = 1, 2, 3... \tag{25}$$

Considering the geometric mean of any 2 successive integers n and $n+1$, the vector model of discrete angular momentum can be obtained.

$$\sqrt{n\,(n+1)}\hbar \cong \sqrt{n\,(n+1)} \cdot N \sqrt{G m_e^3 \left(\frac{R_0}{2}\right)} \quad \text{n} = 1, 2, 3... \tag{26}$$

3.1 To fit the characteristic nuclear charge radius

Experiments reveals that nuclear force is charge independent. From equation(4) and in terms of strong gravity [33,1], considering one nucleon in N number of nucleons, characteristic nuclear charge radius can be fitted in the following way.

$$R_0 \cong \alpha_s \cdot \left(\frac{1}{N}\right)^{\frac{1}{3}} \cdot \frac{2G_A m_n}{c^2} \cong \alpha_s \cdot \left(\frac{m_n}{\sqrt{M_P m_e}}\right) \cdot \frac{2G_A m_n}{c^2} \cong 1.265 \text{ fm} \tag{27}$$

where $\alpha_s \cong 0.11847$ is the strong coupling constant [18,34,35,36]. For A number of nucleons,

$$R_A \cong \alpha_s \cdot \left(\frac{A}{N}\right)^{\frac{1}{3}} \cdot \frac{2G_A m_n}{c^2} \tag{28}$$

Minimum scattering distance between electron and the nucleus can be fitted as

$$r_{min} \cong \left(\frac{\hbar c}{G_A m_e^2}\right)^2 \frac{2G_A m_e}{c^2} \cong \frac{2\hbar^2}{G_A m_e^3} \cong 1.215650083 \text{ fm} \tag{29}$$

Here m_e is the rest mass of electron. This expression is a true reflection of the concepts of strong gravity [1].

$$N \cong \sqrt{\frac{2\hbar^2}{G m_e^3 R_0}} \tag{30}$$

If N is the Avogadro number, value of G can be directly estimated from the atomic physical constants accurately.

$$G \cong \frac{2\hbar^2}{N^2 m_e^3 R_0} \tag{31}$$

Accuracy depends only on the value of R_0. But till today its origin is a mystery.

3.2 To fit the ionic radii of atoms

Similar to the nuclear size, atomic size can be expressed as

$$R_{AI} \cong A^{\frac{1}{3}} \sqrt{\left(\frac{2G_A m_n}{c^2}\right) R_0} \cong A^{\frac{1}{3}} \times 0.0338 \text{ nm} \tag{32}$$

where m_n is the nucleon mass and $\frac{2G_A m_n}{c^2} \cong 9.015 \times 10^{-7}$ m. Considering this expression, characteristic ionic radius of atomic mass number A can be fitted. Ionic radius of Li is 0.076 nm and obtained radius is 0.0646 nm. Ionic radius of Na is 0.102 nm and obtained radius is 0.096 nm. Ionic radius of K is 0.138 nm and obtained radius is 0.115 nm [37].

3.3 To fit the electron rest mass

It is well established that, in β decay, neutron emits an electron and transforms to proton. Thus the nuclear charge changes and the nucleus gets stability. From the semi empirical mass formula [38,39] it is established that,

$$Z \cong \frac{A}{2 + (E_c/2E_a)\, A^{2/3}}. \tag{33}$$

where Z = number of protons of the stable nucleus and A =number of nucleons in the stable nucleus. E_a and E_c are the asymmetry and coulombic energy constants. Semi empirically it is noticed that,

$$A_S \cong 2Z + \frac{Z^2}{S_f} \cong 2Z + \frac{Z^2}{157.069} \tag{34}$$

Here S_f is a new number and can be called as the nuclear stability factor and A_S is stable mass number. With reference to the ratio of neutron and electron rest masses, S_f can be expressed as

$$S_f \cong \sqrt{\alpha} \cdot \frac{m_n}{m_e} \cong 157.0687113 \tag{35}$$

Here α is the fine structure ratio. If Z= 21, A_S = 44.8, Z= 29, A_S = 63.35, Z=47, A_S = 108.06, Z=79, A_S = 197.73 and Z=92, A_S = 237.88. This idea can be given a chance in estimating the stable super heavy elements. By considering A as the fundamental input its corresponding stable Z = Z_S takes the following form.

$$Z_S \cong \left[\sqrt{\frac{A}{157.069} + 1} - 1\right] 157.069 \tag{36}$$

Thus Green's stability formula in terms of Z takes the following form.

$$\frac{0.4A^2}{A + 200} \cong A_S - 2Z \cong \frac{Z^2}{S_f}. \tag{37}$$

Surprisingly it is noticed that this number S_f plays a crucial role in fitting the nucleons rest mass. Another interesting observation is that

$$(m_n - m_p)\, c^2 \cong \ln\left(\sqrt{S_f}\right) m_e c^2 \cong 1.29198 \text{ MeV} \tag{38}$$

Here m_n, m_p and m_e are the rest masses of neutron, proton and electron respectively. Semi empirically by considering Avogadro like number it is noticed that

$$\frac{E_c}{2E_a} \cdot \frac{e^{S_f}}{N} \cong \frac{e^2}{4\pi\varepsilon_0 G m_e^2} \tag{39}$$

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
3	42262.415	to be discovered

Tab. 1: Fitting of charged lepton rest masses.

Electron rest mass can be expressed as

$$m_e \cong \sqrt{\frac{2E_a}{E_c} \cdot \frac{N}{e^{S_f}}} \cdot \sqrt{\frac{e^2}{4\pi\varepsilon_0 G}} \tag{40}$$

Here N is the Avogadro like number. $\frac{e^2}{4\pi\varepsilon_0 G m_e^2}$ is the electromagnetic and gravitational force ratio of electron. In this proposal the important questions are: What is the role of Avogadro like number in β decay ? and How to interpret the expression $\sqrt{\frac{e^2}{4\pi\varepsilon_0 G}}$? This is a multi-purpose expression. Either the value of Avogadro like number or the value of gravitational constant can be fitted. From the semi empirical mass formula if E_a= 23.21 MeV and E_c= 0.71 MeV,

$$G \cong \frac{2E_a}{E_c} \cdot \frac{N}{e^{S_f}} \cdot \frac{e^2}{4\pi\varepsilon_0 m_e^2} \cong 6.6866323 \times 10^{-11} \;\; \mathrm{m^3 Kg^{-1} sec^{-2}} \tag{41}$$

Since all other atomic constants are well measured [36], accuracy of G only depends upon E_a and E_c of the semi empirical mass formula. Multiplying and dividing RHS of equation (40) by N

$$m_e c^2 \cong \sqrt{\frac{2E_a}{E_c} \cdot \frac{N^3}{e^{S_f}}} \cdot \sqrt{\frac{e^2}{4\pi\varepsilon_0} \cdot \frac{c^4}{N^2 G}} \cong X_E \cdot \sqrt{\frac{e^2}{4\pi\varepsilon_0} \cdot \frac{c^4}{N^2 G}} \tag{42}$$

where $X_E \cong \sqrt{\frac{2E_a}{E_c} \cdot \frac{N^3}{e^{S_f}}} \approx 295$ can be called as the 'gravitational mass generator' of electron.

3.4 To fit the Muon and Tau rest masses

Let us define a new number X_E as

$$X_E \cong \sqrt{\frac{4\pi\epsilon_0 G_A m_e^2}{e^2}} \cong 295.0606338 \tag{43}$$

It can be called as the lepton-quark-nucleon gravitational mass generator. It plays a very interesting role in nuclear and particle physics. Inverse of the fine structure ratio is close to

$$\frac{1}{\alpha} \cong \frac{1}{2}\sqrt{X_E^2 - \left[\ln\left(N^2\right)\right]^2} \cong 136.9930484 \cong 137.036 \tag{44}$$

Using $X_E = 295.0606338$, charged muon and tau masses [40] can be fitted as

$$m_l c^2 \cong \left[X_E^3 + \left(n^2 X_E\right)^n \sqrt{N}\right]^{\frac{1}{3}} \;\; E_W \cong \frac{2}{3}\left[E_c^3 + \left(n^2 X_E\right)^n E_a^3\right]^{\frac{1}{3}} \tag{45}$$

Here n= 0,1, 2. E_c and E_a are the coulombic and asymmetric energy constants of the semi empirical mass formula. Qualitatively this expression is connected with β decay. See the table-1. Obtained data can be compared with the PDG recommended charged lepton masses. If electron mass is fitting at n = 0, muon mass is fitting at n = 1 and tau mass is fitting at n = 2 it is quite reasonable and natural to predict a new heavy charged lepton at n = 3. By selecting the proper quantum mechanical rules if one is able to confirm the existence of the number n = 3, existence of the new lepton can be understood. **At n=3 there may exist a heavy charged lepton at 42262 MeV**.

3.5 To fit the weak coupling angle

Note that in electroweak physics weak coupling angle is defined as $\sin\theta_W \cong \sqrt{1-\left(\frac{m_W}{m_Z}\right)^2}$ and $\cos\theta_W \cong \left(\frac{m_W}{m_Z}\right)$ where m_W is rest mass of the electroweak charged boson and m_Z is rest mass of the electroweak neutral boson. In a unified scheme weak coupling angle can be defined as follows.

$$\frac{\text{up quark mass}}{\text{down quark mass}} \cong \frac{1}{\alpha X_E} \cong \sin\theta_W \cong 0.464433353 \tag{46}$$

Considering this new definition, nuclear binding energy constants can be fitted, the 6 quark masses can be fitted. In susy [23,26] the fermion and boson mass ratio Ψ can be fitted as $\Psi^2 \ln\left(1+\sin^2\theta_W\right) \cong 1$. Thus $\Psi \cong 2.262706$.

3.6 To fit the strong coupling constant α_s

The strong coupling constant α_s is a fundamental parameter of the Standard Model. It plays a more central role in the QCD analysis of parton densities in the moment space. QCD dose not predict the actual value of α_s, however it definitely predicts the functional form of energy dependence α_s. The value of α_s, at given energy or momentum transfer scale, must be obtained from experiment. Determining α_s at a specific energy scale is therefore a fundamental measurement, to be compared with measurements of the electromagnetic coupling α_s, of the elementary electric charge, or of the gravitational constant. Considering perturbative QCD calculations from threshold corrections, its recent obtained value at N^{3}LO [35,18] is $\alpha_s \cong 0.1139 \pm 0.0020$. At lower side $\alpha_s \cong 0.1139 - 0.002 = 0.1119$ and at higher side $\alpha_s \cong 0.1139 + 0.002 = 0.1159$. Considering the proposed characteristic strong gravity m_C and m_P mass units strong coupling constant α_s can be fitted or defined in the following way.

$$\frac{1}{\alpha_s} \cong X_S \cong \ln\left(\frac{m_e^2}{m_C m_P}\right) \cong \ln\left(X_E^2\sqrt{\alpha}\right) \cong 8.91424 \cong \frac{1}{0.11218} \tag{47}$$

This proposed value numerically can be compared with the current estimates of the α_s. It is true that the proposed definition is conceptually not matching with the current definitions of the strong coupling constant. But the proposed definition considers all the fundamental gravitational and non-gravitational physical constants in a unified manner. This proposal can be given a chance.

4 Nucleons, nuclear stability and nuclear binding energy constants

1. The characteristic nuclear stability factor is defined as follows.

$$S_f \cong X_E - \frac{1}{\alpha} - 1 \cong 157.0246441 \tag{48}$$

   This number is having multiple applications in nuclear physics.

2. In general nucleon and electron mass ratio is

$$\frac{m_n}{m_e} \cong \frac{S_f}{\sqrt{\alpha}} \cong 1838.167799 \tag{49}$$

3. Nucleon rest energy is close to

$$m_n c^2 \cong X_E \cdot S_f \cdot \sqrt{\frac{\hbar c^5}{G_A}} \cong 939.3017418 \text{ MeV} \tag{50}$$

   At n $= 1$ and 2, with reference to electron rest mass, neutron and proton rest energies can be fitted as

$$\left(mc^2\right)_n \cong X_E \cdot S_f \cdot \sqrt{\frac{\hbar c^5}{G_A}} - x\left(2^x + \frac{E_c}{2E_a}\right) m_e c^2 \text{ where } \mathrm{x} = (-1)^{\mathrm{n}} \tag{51}$$

Neutron rest energy is very close to

$$\left(mc^2\right)_1 \cong m_n c^2 \cong X_E \cdot S_f \cdot \sqrt{\frac{\hbar c^5}{G_A}} + \left(\frac{1}{2} + \frac{E_c}{2E_a}\right) m_e c^2 \ \text{ where } \ \mathrm{n = 1, x = -1} \tag{52}$$

Proton rest energy is very close to

$$\left(mc^2\right)_2 \cong m_p c^2 \cong X_E \cdot S_f \cdot \sqrt{\frac{\hbar c^5}{G_A}} - \left(2 + \frac{E_c}{2E_a}\right) m_e c^2 \ \text{ where } \ \mathrm{n = 2, x = 1} \tag{53}$$

If $E_c \cong 0.71$ MeV and $E_a \cong 23.21 MeV$, $m_n c^2 \cong 939.565057$ MeV and $m_p c^2 \cong 938.2719282$ MeV [40]. Thus neutron and proton rest energy difference is close to

$$m_n c^2 - m_p c^2 \cong \left(2.5 + \frac{E_c}{2E_a}\right) m_e c^2 \tag{54}$$

4. Interesting observation is $\frac{E_c}{2E_a} \cong X_E \alpha^2$. With in the nucleus proton and nucleon stability relation can be expressed as, stable mass number

$$A_S \cong 2Z + \frac{Z^2}{S_f} \ \text{ where Z is the proton number} \tag{55}$$

5. Semi empirical mass formula coulombic energy constant can be expressed as

$$E_c \cong \frac{\alpha}{X_S} \cdot m_p c^2 \cong \alpha \cdot \alpha_s \cdot m_p c^2 \cong 0.7681 \ \text{ MeV} \tag{56}$$

6. Pairing energy constant is close to

$$E_p \cong \frac{m_p c^2 + m_n c^2}{S_f} \cong 11.959 \text{ MeV} \tag{57}$$

Asymmetry energy constant can be expressed as

$$E_a \cong 2E_p \cong 23.918 \text{ MeV} \tag{58}$$

7. (Volume and surface energy constants) & (asymmetric and pairing energy constants) can be co-related as

$$E_a - E_v \cong E_s - E_p \cong (X_S + 1) E_c \cong 7.615 \text{ MeV} \tag{59}$$

$$E_v + E_s \cong E_a + E_p \cong 3E_p \tag{60}$$

Thus $E_v \cong 16.303$ MeV and $E_s \cong 19.574$ MeV

8. It is also noticed that,

$$\frac{E_a}{E_v} \cong 1 + \sin\theta_W \ \text{ and } \ \frac{\mathrm{E_a}}{\mathrm{E_s}} \cong 1 + \sin^2\theta_\mathrm{W} \tag{61}$$

Thus $E_v \cong 16.332$ MeV and $E_s \cong 19.674$ MeV.

9. Nuclear binding energy can be fitted with 2 terms or 5 factors with $E_c \cong 0.7681$ MeV as the single energy constant. First term can be expressed as

$$T_1 \cong (f)(A+1)\ln\left[(A+1) X_S\right] E_c \tag{62}$$

Ssecond term can be expressed as

$$T_2 \cong \left[\frac{A^2 + \left(f.Z^2\right)}{X_S^2}\right] E_c \tag{63}$$

where $f \cong 1 + \frac{2Z}{A_S} \cong \frac{4S_f + Z}{2S_f + Z} < 2$ and $A_S \cong 2Z + \frac{Z^2}{S_f} \cong 2Z + \frac{Z^2}{157.025}$. Close to the stable mass number, binding energy

$$B \cong T_1 - T_2 \tag{64}$$

Quark	Rest energy in MeV
Up	4.4
Down	9.48
Strange	152.58
Charm	1313.8
Bottom	5287.58
Top	182160.18

Tab. 2: **Proposed quark rest energies**.

5 To fit the quark rest masses and the strong coupling constant (α_s)

Quark rest masses can be obtained in the following way [20] .

1. Relation between electron rest mass and up quark rest mass can be expressed as

$$\frac{Uc^2}{m_e c^2} \cong \left[\frac{G_A m_e^2}{\hbar c}\right]^{\frac{1}{3}} \cong 8.596650881 \cong e^{\alpha X_E} \tag{65}$$

2. Relation between up quark and down quark rest masses is

$$\frac{Dc^2}{Uc^2} \cong \ln\left[\frac{Uc^2}{m_e c^2}\right] \cong 2.151372695 \cong \alpha X_E \cong \frac{1}{\sin\theta_W} \tag{66}$$

3. Up, strange and bottom quarks are in first geometric series and Down, charm and top quarks are in second geometric series.

4. First generation USB geometric ratio is

$$g_U \cong \left[\frac{D}{U} \cdot \frac{D+U}{D-U}\right]^2 \cong \left[\alpha X_E \cdot \frac{\alpha X_E + 1}{\alpha X_E - 1}\right]^2 \cong 34.66 \tag{67}$$

and the second generation DCT geometric ratio is

$$g_D \cong \left[2 \cdot \frac{D}{U} \cdot \frac{D+U}{D-U}\right]^2 \cong \left[2 \cdot \alpha X_E \cdot \frac{\alpha X_E + 1}{\alpha X_E - 1}\right]^2 \cong 138.64 \cong 4 g_U \tag{68}$$

5. Surprisingly it is also noticed that

$$\frac{1}{\alpha_s} \cong \ln(g_U g_D) \cong 8.4747 \cong \frac{1}{0.1179598} \tag{69}$$

6. Interesting observation is

$$\left(\frac{1}{\alpha} + \frac{1}{\alpha_s}\right)\sqrt{UD} \cdot c^2 \cong m_n c^2 \cong 939 \text{ MeV} \tag{70}$$

$$\frac{\sqrt{UD} \cdot c^2}{(m_n - m_p)\, c^2} \cong \ln\left(\frac{1}{\alpha} + \frac{1}{\alpha_s}\right) \tag{71}$$

where m_p and m_n are the rest mass of proton and neutron. Please see the estimated quark rest energies in table-2.

6 Discussion

For any theory, its success depends on its mathematical formulation as well as its workability in the observed physical phenomena. Initially string theory was originated in an attempt to describe the strong interactions. It is having many attractive features. Then it must explain the ratio of (3+1) dimensional strong interaction strength and the gravitational interaction strength. Till date no single hint is available in this direction. This clearly indicates the basic draw back of the current state of the art string theory. Equations (6,8,10,13,20,22,23,27,29,32,39 and 43 to 71) clearly shows the applications of the proposed atomic gravitational constant in different ways. In this connection it can be suggested that,

1. Atomic or nuclear gravitational constant is $G_A \cong N^2 G$. Whether it is real or effective has to be confirmed by further research, analysis and experiments.
2. Lepton-quark-nucleon mass generator is $X_E \cong \sqrt{\frac{4\pi\epsilon_0 G_A m_e^2}{e^2}} \cong 295.0606338$
3. Nuclear stability factor is $S_f \cong X_E - \frac{1}{\alpha} - 1$
4. Inverse of the strong coupling constant is $X_S \cong \ln\left(X_E^2\sqrt{\alpha}\right) \cong 8.91424$.

7 Conclusion

Developing a true unified theory at 'one go' is not an easy task. Qualitatively and quantitatively proposed new concepts and semi empirical relations can be given a chance in understanding and developing the unified concepts. If one is able to fine tune the String theory or Supergravity with the proposed atomic gravitational constant (with in the observed 3+1 dimensions), automatically planck scale, nuclear scale and atomic scales can be interlinked into a theory of strong (nuclear) gravity.

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References

[1] Recami E. Elementary Particles as Micro-Universes, and Strong Black-holes: A Bi-Scale Approach to Gravitational and Strong Interactions. Preprint NSF-ITP-02-94.

[2] Halpern, Paul (2004). The Great Beyond: Higher Dimensions, Parallel Universes, and the Extraordinary Search for a Theory of Everything. Hoboken, New Jersey: John Wiley & Sons, Inc.. p. 326. ISBN 0-471-46595-X.

[3] Smolin, Lee (2006). The Trouble with Physics: The Rise of String Theory, the Fall of a Science, and What Comes Next. New York: Houghton Mifflin Co.. p. 392. ISBN 0-618-55105-0.

[4] Woit, Peter (2006). Not Even Wrong - The Failure of String Theory And the Search for Unity in Physical Law. London: Jonathan Cape &: New York: Basic Books. p. 290. ISBN 978-0-465-09275-8.

[5] E. Cremmer, B. Julia and J. Scherk. Supergravity theory in eleven dimensions, Physics Letters B76 (1978) pp 409-412.

[6] Wess, Julius; Bagger, Jonathan (1992). Super symmetry and Supergravity. Princeton University Press. pp. 260. ISBN 0691025304.

[7] David Gross, Einstein and the search for Unification. Current science, Vol. 89, No. 12, 25 Dec 2005.

[8] Witten, Edward. Search for a realistic Kaluza-Klein theory. Nuclear Physics B 186 (3): 412- 428. 1981

[9] P. A. M. Dirac, The cosmological constants. Nature, 139, 323, 1937.

[10] P. A. M. Dirac, A new basis for cosmology. Proc. Roy. Soc. A 165, 199, 1938.

[11] Abdus Salam. Einstein's Last Dream: The Space -Time Unification of Fundamental Forces, Physics News, Vol.12, No.2 (June 1981), p.36.

[12] Tilman Sauer, Einstein's Unified Field Theory Program. The Cambridge Companion to Einstein, M. Janssen, C. Lehner (eds). Cambridge University Press.

[13] Hawking S.W. A Brief History of Time. Book. Bantam Dell Publishing Group. 1988.

[14] U. V. S. Seshavatharam, Physics of rotating and expanding black hole universe. Progress in Physics, Vol-2, April, 2010. Page 7-14.

[15] U. V. S. Seshavatharam and S. Lakshminarayana. Unified model of universe and the atom. Book. ISBN: 9783843393966, LAP LAMBERT Academic Publishing GmbH & Co. KG, Germany, 2011 March.

[16] Salam A, Sivaram C. Strong Gravity Approach to QCD and Confinement. Mod. Phys. Lett., 1993, v. A8(4), 321-326.

[17] P. Caldirola, M. Pavisc and Recami E. Explaining the Large Numbers by a Hierarchy of **Universes**: A Unified Theory of Strong and Gravitational Interactions. IL Nuovo Cimento Vol. 48 B, No. 2, 11 Dec 1978.

[18] Recami E and V. T. Zanchin. The strong coupling constant: its theoretical derivation from a geometric approach to hadron structure. Foundations of Physics letters, vol-7, no.1, 1994.

[19] V. T. Zanchin and Recami E. Regge like relations for stable (non-evaporating) black holes. Foundations of Physics letters, vol-7, no.2, 1994.

[20] Abdus Salam. Strong Interactions, Gravitation and Cosmology. Publ. in: NATO Advanced Study Institute, Erice, June16-July 6, 1972 .

[21] S. I. Fisenko, M. M. Beilinson and B. G. Umanov. Some notes on the concept of strong gravitation and possibilities of its experimental investigation. Physics Letters A, Vol-148, Issues 8-9, 3 Sep 1990, pp 405-407.

[22] Fedosin S.G. Model of Gravitational Interaction in the Concept of Gravitons. Journal of Vectorial Relativity, Vol. 4, No. 1, March 2009, P.1-24.

[23] U. V. S. Seshavatharam and S. Lakshminarayana, Super Symmetry in Strong and Weak interactions. Int. J. Mod. Phys. E, Vol.19, No.2, (2010), p.263.

[24] U. V. S. Seshavatharam and S. Lakshminarayana, Role of Avogadro number in grand unification. Hadronic Journal. Vol-33, No 5, 2010 Oct. p513.

[25] U. V. S. Seshavatharam and S. Lakshminarayana, Atomic gravitational constant and the origin of elementary magnetic moments. Hadronic journal, Vol-33, 655- 680 (2010).

[26] U. V. S. Seshavatharam and S. Lakshminarayana, SUSY and strong nuclear gravity in (120-160) GeV mass range. Hadronic journal, Vol-34, No 3, 2011 June, p277-300

[27] U. V. S. Seshavatharam and S. Lakshminarayana, To confirm the existence of atomic gravitational constant. Hadronic journal, Vol-34, No 4, 2011 August, p 379.

[28] U. V. S. Seshavatharam and S. Lakshminarayana, Strong nuclear gravity- a brief report. Hadronic journal, Vol-34, No 4, 2011 August, p 425.

[29] U. V. S. Seshavatharam and S. Lakshminarayana, Strong nuclear gravitational constant and the origin of nuclear planck scale. Progress in Physics, vol. 3, July, 2010, p. 31-38.

[30] U. V. S. Seshavatharam and S. Lakshminarayana, (N/2) neutrons, (N/2) protons and (N/2) electrons. Journal of Nuclear Physics, Italy. Nov 2010.

[31] Joshua A. Frieman et al. Dark energy and the accelerating universe. http://arxiv.org/abs/0803.0982v1.

[32] Geiger H and Marsden E. On a difuse reection of the particles. Proc. Roy. Soc., Ser. A 82: 495500, 1909.

[33] Schwarzschild K. On the gravitational field of a mass point according to Einstein's theory. Sitz. der Koniglich Preuss. Akad. der Wiss, 1916, v. 1, 189-196.

[34] C. Amsler et al. (Particle Data Group) (2008). Review of Particle Physics Electroweak model and constraints on new physics.

[35] S. Atashbar Tehrani and A. N. Khorramian. Determination of the strong coupling constant using available experimental data. CPC(HEP & NP), 2010, 34(9): 1485-1487. Vol. 34, No. 9, Sep., 2010

[36] P. J. Mohr and B. N. Taylor, CODATA Recommended Values of the Fundamental Physical Constants.2007. Http://physics.nist.gov/constants.

[37] Jim Clark. Atomic and ionic radius.
http://www.chemguide.co.uk/atoms/properties/atradius.html

[38] W. D. Myers et al. Table of Nuclear Masses according to the 1994 Thomas-Fermi Model.(from nsdssd.lbl.gov)

[39] P. Roy Chowdhury et al. Modified Bethe-Weizsacker mass formula with isotonic shift and new driplines. (http://arxiv.org/abs/nucl-th/0405080).

[40] Particle Data Group (W.-M. Yao et al.), J. Phys. G 33 (2006) 1, http://pdg.bbb.gov.