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On the Compactification and Reformation of String Theory with Three Large Atomic Gravitational Constants

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Abstract:. Within the scope of observed materialistic physical systems, without addressing the roots of H-Bar and big G, it is impossible to construct a workable model of final unification. With reference to our earlier proposed three large atomic gravitational constants, it is possible to reform and compactify the 10 dimensional String theory to 3+1 dimensions

Keywords: String theory; Three atomic gravitational constants; 3+1 dimensions; 4G model of final unification; Microscopic Quantum Gravity;

List of symbols	
1) Newtonian gravitational constant = G_N	14) Magnetic moment of proton = μ_p
2) Electromagnetic gravitational constant= G_e	15) Weak interaction string tension= F_w
3) Nuclear gravitational constant = G_s	16) Strong interaction string tension= F_s
4) Weak gravitational constant = G_w	17) Electromagnetic interaction string tension= F_e
5) Fermi's weak coupling constant = G_F	18) Gravitational interaction string tension= F_g
6) Strong coupling constant = α_s	19) Weak interaction string potential= E_w
7) Electroweak fermion = M_w	20) Strong interaction string potential = E_s
8) Reduced Planck's constant = $\hbar$	21) Electromagnetic interaction string potential = E_e
9) Speed of light = c	22) Gravitational interaction string potential = E_g
10) Elementary charge = e	23) Fine structure ratio = α
11) Strong nuclear charge = e_s	24) Nuclear fine structure ratio = α_n
12) Mass of proton = m_p	
13) Mass of electron = m_e	

1. Introduction

Subject of final unification is very interesting and very challenging. Unifying gravity and quantum mechanics (QM) is very much complicated and scientists are trying their level best in different ways. As gravitational effects are negligible at quantum level, standard model of particle physics attempts to explore the secrets of elementary particles. On the other hand, as quantum effects are negligible at macroscopic level, General theory of relativity (GTR) attempts to explore the secrets of the universe. The most complicated question to be answered is – If celestial objects are confirmed to be made up of various kinds of atoms, whether 'gravity' is causing the atoms to form into celestial spheres or quantum rules are causing the atoms to form into celestial spheres that show gravity?

Astrophysics point of view or 'Planck scale' point of view, there is a possibility of observing the combined effects of GTR and QM at intermediate energy scales. In between GTR and QM, there exist fascinating and most complicated astrophysical objects, i.e. Black holes. Even though their detection is a great mystery, one can see the best possibility of understanding QM and GTR at extreme energy scales. Here, we would like to emphasize the point that, astrophysical observations pertaining to Black holes and various other compact stellar objects just reveal the combined effects of GTR and QM but no way indicating the secrets of unification of QM and GTR. One most common point of QM and GTR is "mass". By understanding the massive origin of elementary particles, it may be possible to probe the secrets of QM and GTR.

The primary goal of quantum gravity is to join the laws of quantum mechanics with the laws of general relativity into a single mathematically consistent framework. Many scientists believe that, String theory [1,2] is one best candidate of quantum gravity. It is embedded with beautiful physical concepts like open strings, closed strings, string vibrations, string length, string tension and 'fermion-boson super symmetry'. Scientists strongly believe that, String theory is empowered with good mathematics and smartly fits gravity in unification program. Point to be noted is that, by considering the Planck length as characteristic amplitude associated with strings, String theory advances its ideological representation. Very unfortunate thing is that, even though, originally, String theory was proposed for understanding 'strong interaction, as Planck length is 20 orders of magnitude less than nuclear size, it is badly failing in explaining and predicting nuclear scale physical phenomena. Here we would like to stress the point that, the main reason for its fatal failure is – "implementation of the two famous physical constants H-bar and big G as-they-are". We would like to say that, without addressing the roots of H-Bar and big G, it is impossible to construct a workable model of final unification.

2. Extra dimensions and inadequacy of String theory

The mathematics used in superstring theory requires at least 10 dimensions. String theorists believe that extra dimensions are wrapped up in the curled-up space first described by Kaluza and Klein [3,4,5,6]. We would like to emphasize the following points.

1) The major inadequacy of String theory is – Extra dimensions. When there is no experimental evidence for extra dimensions, building a fundamental theory based on extra dimensions seems to be ad-hoc, misleading and speculative. Instead of extra dimensions, various utmost basic physical properties like mass, charge, density, radius, binding energy, magnetic moment, melting temperature, boiling temperature and solidification temperature can be considered as various angles of assessing the applicability of any fundamental theory.
2) Logically speaking, if 3+1 dimensions demonstrate 4 different basic interactions, 9+1 dimensions can have a minimum of 10 different new interactions. Clearly speaking, instead of finding unified solutions for 3+1 dimensional basic interactions, unknowingly scientists are falling in a much more complex situation.
3) The basic question to be answered is, when the four basic interactions are being well operated in 3+1 dimensions simultaneously, what is the necessity of introducing extra dimensions in understanding their unification scheme? When nobody is clear about the basics and existence of 5^{th} dimension, it is ad hoc to say that, electromagnetism and gravity seems to have similar behaviour in 5^{th} dimension.

4) Since 1920, no experiment has given a single (direct or indirect) clue for the existence of 5th dimension (https://gizmodo.com/isthere-a-fifth-dimension-1832939412). By comparing the measurements of gravitational waves and light as they propagated through space, physicists at Laser interferometer gravitational-wave observatory LIGO [7] were able to determine whether these two different waveforms were experiencing the same number of dimensions of spacetime. According to their experimental study [8], the measurements of the neutron star collision suggest that both gravitational waves and particles of light experience four dimensions (three spatial dimensions plus time). Based on this inference, it seems possible to say that, evidence for the existence of higher dimensions is poor. If so, guessing about the existence of 10 to 26 dimensions may not be a right choice at fundamental level.
5) When nobody knows a single individual physical property of any 4+1 dimensional physical system, discussing and studying about extra-dimensions is illogical.
6) So far, currently believed String theory models did not shed light on uncompactification of hidden multi-dimensions and acquiring of mass in 3+1 dimensions.
7) When there is no theoretical procedure for indentifying 4+1 dimensional physical phenomena, trying to identify any unknown 4+1 dimensional physical phenomenon with an apparatus or equipment predesigned with 3+1 dimensional procedure is another ad-hoc idea. If there is any possibility of inferring something from any such experiment, it needs a careful analysis with reference to an un-identified or new 3+1 dimensional physical phenomenon.
8) When existence of any extra-dimensional physical system is uncertain, it is impossible to assess or confirm the reality of mathematics associated with its study.
9) There is no guarantee that, current laws of 3+1 dimensional physics will work in extra-dimensions.
10) When H-Bar and big G are confirmed to be practically associated with 3+1 dimensions, applying them to unidentified extra dimensional physical models seem to be misguiding. Fundamental question to be answered is - How the magnitudes of 3+1 physical constants are getting modified in extra-dimensions?– As nobody has witnessed any extra dimensional physical system, this question cannot be answered and cannot be ignored.
11) Strings and string properties can also be studied with 3+1 dimensions.
12) When wave nature of particle is well established experimentally, particle waves can be considered as a characteristic representation of vibrating and moving strings.
13) No one can be against to the idea of multi universes but extra-dimensions may not be practical.

3. Three large gravitational coupling constants

When mass of any elementary particle is extremely small/negligible compared to macroscopic bodies, highly curved microscopic space-time can be addressed with large gravitational constants and magnitude of elementary gravitational constant seems to increase with decreasing mass and increasing interaction range. Based on this logic, we consider the possibility of existence of three large gravitational constants assumed to be associated with the electromagnetic, strong and weak interactions [9-23]. Compared to multi-dimensions and unproved maths of any String theory model, our proposal can be given some positive consideration. Following the notion of string theory, compactification of un-observable spatial dimensions might be playing a key role in hiding the large magnitudes of the three atomic gravitational constants. If multi dimensional physics is having a real sense, then, compactification of large magnitudes of atomic gravitational constants can also be possible.

By following our idea, in analogy with Planck scale, as an immediate result, it seems possible to have three different string amplitudes corresponding to electromagnetic, strong and weak interactions. In this way, String theory can be shaped to a model of elementary particle physics associated with 3+1 dimensions. Another advantage is that, considering the combined effect of the three atomic gravitational constants, origins of H-Bar and big G can be understood. Including the Newtonian gravitational constant, as the subject under consideration deals with 4 different gravitational constants, our model can be called as 4G model of final unification or Microscopic Quantum Gravity. With further study, Planck scale and electroweak scale can be studied in a unified manner. During cosmic evolution, if one is willing to give equal importance to Higgs boson and Planck mass in understanding the massive origin of elementary particles, then it seems quite logical to expect a common relation between Planck scale and Electroweak scale.

4. Our basic assumptions

We propose the following four assumptions [14-21].

1) Each atomic interaction is associated with a characteristic gravitational coupling constant and the corresponding values are,

$$\left.\begin{aligned} G_e &\cong 2.374335\times10^{37}\ \text{m}^3\text{kg}^{-1}\text{sec}^{-2} \\ G_s &\cong 3.329561\times10^{28}\text{m}^3\text{kg}^{-1}\text{sec}^{-2} \\ G_w &\cong 2.909745\times10^{22}\ \text{m}^3\text{kg}^{-1}\text{sec}^{-2} \\ G_N &\cong 6.679855\times10^{-11}\ \text{m}^3\text{kg}^{-1}\text{sec}^{-2} \end{aligned}\right\}$$

2) There exists a strong interaction elementary charge $(e_s) \cong 2.9463591e$ in such a way that, it's squared ratio with normal elementary charge is close to reciprocal of the strong coupling constant.
3) There exists a characteristic electroweak fermion of rest energy, $M_w c^2 \cong 584.725$ GeV. It can be considered as the zygote of all elementary particles.
4) Fermion-Boson mass ratio is 2.27 [21, 22, 23].

5. Inferences and consequences of above four assumptions

Readers are encouraged to see our recently published papers [16-21] for possible introduction, and applications. Most important relations can be expressed as follows. We have made an attempt to derive them in a semi empirical approach [17].

$$\hbar c \cong G_w M_w^2 \tag{1}$$

$$G_F \cong G_w M_w^2 R_w^2$$
$$\text{where, } R_w \cong \left(2G_w M_w / c^2\right) \tag{2}$$

$$m_e \cong \left(\frac{G_w}{G_s}\right) M_w \tag{3}$$

$$m_p \cong \left(\frac{G_s^2}{G_w G_e}\right) M_w \tag{4}$$

$$\frac{m_p}{m_e} \cong \frac{G_s^3}{G_w^2 G_e} \tag{5}$$

$$\hbar c \cong \left(\frac{G_e G_w}{G_s}\right) m_p m_e \cong G_s M_w m_e \tag{6}$$

$$\left(\frac{e_s}{e}\right) \cong \frac{G_s m_p^2}{G_w M_w^2} \cong \frac{G_s^5}{G_e^2 G_w^3} \tag{7}$$

$$\left(\frac{e_s}{e}\right)^2 \cong \frac{1}{\alpha_s} \cong \frac{G_s^{10}}{G_e^4 G_w^6} \tag{8}$$

$$G_N \cong \frac{G_w^{21} G_e^{10}}{G_s^{30}} \tag{9}$$

6. Applications of assumption-1

'String tension' [24] is a practical aspect of String theory. Considering the proposed three atomic gravitational constants and following the universal applicability of 'speed of light', approximate tensions associated with weak, strong, electromagnetic and gravitational interactions can be represented by,

$$,\quad \left\{\begin{array}{l} F_w \cong \left(\frac{c^4}{4G_w}\right) \cong 6.94\times 10^{10}\text{ N} \\ F_s \cong \left(\frac{c^4}{4G_s}\right) \cong 6.065\times 10^{4}\text{ N} \\ F_e \cong \left(\frac{c^4}{4G_e}\right) \cong 8.505\times 10^{-5}\text{ N} \\ F_g \cong \left(\frac{c^4}{4G_N}\right) \cong 3.026\times 10^{43}\text{ N} \end{array}\right\} \tag{10}$$

Following the universal applicability of 'elementary charge', approximate (operating) energy potentials associated with above string tensions can be represented by,

$$\left\{\begin{array}{l} E_w \cong \sqrt{\frac{e^2}{4\pi\varepsilon_0}\left(\frac{c^4}{4G_w}\right)} \cong 25.0 \text{ GeV} \\ E_s \cong \sqrt{\frac{e^2}{4\pi\varepsilon_0}\left(\frac{c^4}{4G_s}\right)} \cong 23.3 \text{ MeV} \\ E_e \cong \sqrt{\frac{e^2}{4\pi\varepsilon_0}\left(\frac{c^4}{4G_e}\right)} \cong 874 \text{ eV} \\ E_g \cong \sqrt{\frac{e^2}{4\pi\varepsilon_0}\left(\frac{c^4}{4G_N}\right)} \cong 8.355\times 10^7 \text{ J} \end{array}\right\} \tag{11}$$

These estimated weak, strong and electromagnetic energy potentials seem to be close to experimental values.

7. Applications of assumption-2

Using the proposed strong nuclear charge e_s, proton magnetic moment $\mu_p \cong \frac{e_s\hbar}{2m_p} \cong \frac{eG_s m_p}{2c} \cong 1.488\times 10^{-26}$ J/Tesla, nuclear fine structure ratio $\alpha_n \cong \frac{e_s^2}{4\pi\varepsilon_0\hbar c} \cong 0.063345$, neutron life time [25], $t_n \cong \left(\frac{G_e^2 m_n^2}{G_w\left(m_n - m_p\right)c^3}\right) \cong 875 \text{ sec}$, unified nuclear binding energy coefficient [19,20], $B_0 \cong \frac{1}{2}\sqrt{\alpha\times\alpha_n}\left(m_p c^2\right) \cong 10.09 \text{ MeV}$ and Fermi gas model of nuclear potential $E_F \cong \sqrt{\alpha\times\alpha_n}\left(m_p c^2 + m_n c^2\right) \cong 40.37 \text{ MeV}$ can be fitted. With reference to the current experimental values of root mean square radius of proton, (0.833 ± 0.01) fm [26] and $(0.831 \pm 0.007_{stat} \pm 0.012_{syst})$ fm [27], we noticed one interesting relation. It can be expressed as,

$$\left.\begin{array}{l} R_p \cong \sqrt{\left(\frac{4\pi\varepsilon_0\hbar^2}{e_s^2 m_p}\right)\left(\frac{\hbar}{m_p c}\right)} \\ \cong \sqrt{\frac{4\pi\varepsilon_0\hbar^3}{e_s^2 m_p^2 c}} \cong 0.835 \text{ fm} \end{array}\right\} \tag{12}$$

In this relation,

a) $\left(\frac{4\pi\varepsilon_0\hbar^2}{e_s^2 m_p}\right) \cong 3.32 \text{ fm}$ can be inferred as the Bohr's model of probable distance of finding proton in the nuclear well where the operating charge is $e_s \cong 2.946e$.

b) $\left(\frac{\hbar}{m_p c}\right) \cong 0.21 \text{ fm}$ can be considered as the reduced Compton wavelength of proton.

Based on relation (12),

$$\left[\left(\frac{e_s^2}{4\pi\varepsilon_0 c}\right)\left(m_p R_p c\right)^2\right]^{\frac{1}{3}} \cong \hbar \tag{13}$$

8. Applications of assumptions-2, 3 and 4

Based on the beautiful concepts of Super symmetry, we tried our level best to explore Strong interaction in the view of the existence of Quark fermions and Quark bosons. We emphasize that, 1) Strong interaction is one best platform for observing and confirming super symmetry (SUSY); 2) All observed baryons and mesons are SUSY particles only; 3) SUSY particles exist at all energy scales and are within the reach of current accelerators. For details, readers are encouraged to see our recently published paper [21].

9. Conclusion

With further study, research and mathematical analysis, retaining the originality of physics, string theory models can be compactified to 3+1 dimensions. In a progressive manner, by thoroughly exploring and collecting the possible experimental evidences for extra dimensions, future research can be carried out with ease.

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