Atom, Fine structure ratio and the Universe

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Abstract: In the universe, if the critical density is $\rho_c \cong \left(3H_0^2/8\pi G\right)$ and the characteristic Hubble radius is $R_0 \cong (c/H_0)$, mass of the cosmic Hubble volume is $M_0 \cong \frac{c^3}{2GH_0}$. There exists a charged heavy massive elementary particle M_X in such a way that, inverse of the fine structure ratio is equal to the natural logarithm of the sum of number of positively and negatively charged M_X in the Hubble volume. Surprisingly it is noticed that, M_X mass is close to Avogadro number times the rest mass of electron. It is noticed that M_X plays a very interesting role in particle and nuclear physics. In addition to these ideas it can also be suggested that, for any observable charged particle, there exists 2 kinds of masses and their mass ratio is $X_E \cong 295.0606339$ and if $\hbar$ is the quanta of the gravitational angular momentum, then the electromagnetic quanta can be expressed as $\left(\frac{\hbar}{X_E}\right)$.

Keywords: Atom, Avogadro number, Hubble radius, Hubble volume, Hubble mass, Mach's principle, Planck mass, Coulomb mass, Fine structure ratio, the 4 fundamental interactions and SUSY.

1 Mach's principle - Hubble volume - Hubble mass

In theoretical physics, particularly in discussions of gravitation theories, Mach's principle [1-6] is the name given by Einstein to an interesting hypothesis often credited to the physicist and philosopher Ernst Mach. The idea is that the local motion of a rotating reference frame is determined by the large scale distribution of matter. There are a number of rival formulations of the principle. A very general statement of Mach's principle is 'local physical laws are determined by the large-scale structure of the universe'. This concept was a guiding factor in Einstein's development of the general theory of relativity. Einstein realized that the overall distribution of matter would determine the metric tensor, which tells the observer which frame is rotationally stationary. Note that till today quantitatively Mach's principle was not implemented successfully in cosmic and nuclear physics. With reference to the Hubble radius $R_0 \cong \frac{c}{H_0}$, Hubble mass can be expressed as $M_0 \cong \frac{c^3}{2GH_0}$. Considering the Mach's principle and the Hubble mass, in this paper an attempt is made to understand the origin of the cosmic and strong interaction physical parameters. In modern cosmology, the shape of the universe is flat. In between the closed space and flat space, there is one compromise. That is 'Hubble volume'. Note that Hubble volume is only a theoretical and spherical expanding volume and is virtual. From Hubble volume one can estimate the Hubble mass. By coupling the Hubble mass with the Mach's principle, one can understand the origin of cosmic and atomic physical parameters.

1.1 To unify the atom and the universe

The subject of unification is very interesting and very complicated [7-18]. By implementing the Avogadro number N as a scaling factor in unification program, one can probe the constructional secrets of elementary particles. The Planck's quantum theory of light, thermodynamics of stars, black holes and cosmology totally depends upon the famous Boltzmann constant k_B which in turn depends on the Avogadro number [19]. From this it can be suggested that, Avogadro number is more fundamental and characteristic than the Boltzmann constant and indirectly plays a crucial role in the formulation of the quantum theory of radiation. In this connection it is noticed that, 'molar electron mass' plays a very interesting role in nuclear and particle physics.

1.2 Key concepts in unification

Concept-1

In the expanding cosmic Hubble volume, characteristic cosmic Hubble mass is the product of the cosmic critical density and the Hubble volume. If the critical density is $\rho_c \left(3H_0^2/8\pi G\right)$ and characteristic Hubble radius is $R_0 \cong (c/H_0)$, mass of the cosmic Hubble volume is

$$M_0 \cong \frac{c^3}{2GH_0} \tag{1}$$

Concept-2

There exists a charged heavy massive elementary particle M_X in such a way that, inverse of the fine structure ratio is equal to the natural logarithm of the sum of number of positively and negatively charged M_X in the Hubble volume. If the number of positively charged $(M_X)^+$ is $\left(\frac{M_0}{M_X}\right)$ and the number of negatively charged $(M_X)^-$ is also $\left(\frac{M_0}{M_X}\right)$ then

$$\frac{1}{\alpha} \cong \ln\left(\frac{M_0}{M_X} + \frac{M_0}{M_X}\right) \cong \ln\left(\frac{2M_0}{M_X}\right) \tag{2}$$

From experiments $1/\alpha \cong 137.0359997$ and from the current observations [20,21,22], magnitude of the Hubble constant is, $H_0 \cong 70.4^{+1.3}_{-1.4}$ Km/sec/Mpc.Thus

$$M_X \cong e^{-\frac{1}{\alpha}}\left(\frac{c^3}{GH_0}\right) \cong e^{-\frac{1}{\alpha}} \cdot 2M_0 \cong (5.32 \text{ to } 5.53) \times 10^{-7} \text{ Kg} \tag{3}$$

If $N \cong 6.022141793 \times 10^{23}$ is the Avogadro number and m_e is the rest mass of electron, surprisingly it is noticed that, $N.m_e \cong 5.485799098 \times 10^{-7}$ Kg and this is close to the above estimation of M_X. Thus it can be suggested that,

$$\frac{M_X}{m_e} \cong N \tag{4}$$

In this way, Avogadro number can be coupled with the cosmic, atomic and particle physics. Then with reference to $(N.m_e)$, the obtained cosmic Hubble mass is $M_0 \cong 8.957532458 \times 10^{52}$ Kg and thus the obtained Hubble's constant is $H_0 \cong \frac{c^3}{2GM_0} \cong 69.54$ Km/sec/Mpc. Note that large dimensionless constants and compound physical constants reflects an intrinsic property of nature [23,24]. Whether to consider them or discard them depends on the physical interpretations, logics, experiments, observations and our choice of scientific interest. In most of the critical cases, 'time' only will decide the issue. The mystery can be resolved only with further research, analysis, discussions and encouragement.

Concept-3

For any observable charged particle, there exists 2 kinds of masses and their mass ratio is 295.0606339. Let this number be represented by X_E. First kind of mass seems to be the 'gravitational or observed' mass and the second kind of mass seems to be the 'electromagnetic' mass. Ratio of gravitational and electromagnetic mass ratio is X_E. This idea can be applied to proton and electron.

This number is obtained in the following way. In the Planck scale, similar to the Planck mass, with reference to the elementary charge, a new mass unit can be constructed in the following way.

$$M_C \cong \sqrt{\frac{e^2}{4\pi\varepsilon_0 G}} \cong 1.859210775 \times 10^{-9} \text{ Kg} \tag{5}$$

$$M_C c^2 \cong \sqrt{\frac{e^2 c^4}{4\pi\varepsilon_0 G}} \cong 1.042941 \times 10^{18} \text{ GeV} \tag{6}$$

Here 'e' is the elementary charge. How to interpret this mass unit? Is it a primordial massive charged particle? If 2 such oppositely charged particles annihilates, a large amount of energy can be released. Considering so many such pairs annihilation hot big bang or inflation can be understood. This may be the root cause of cosmic energy reservoir. Such pairs may be the chief constituents of black holes. In certain time interval with a well defined quantum rules they annihilate and release a large amount of energy in the form of γ photons. In the Hubble volume, with its pair annihilation, origin of the CMBR can be understood. Thus

$$\frac{M_X}{M_C} \cong 295.0606338 \cong X_E \tag{7}$$

Clearly speaking, gravitational and electromagnetic force ratio of M_X is X_E^2.

$$\frac{M_X}{M_C} \cong \sqrt{\frac{4\pi\epsilon_0 G M_X^2}{e^2}} \cong 295.0606338 \tag{8}$$

It cab be interpreted that, if 5.486×10^{-7} Kg is the observable or gravitational mass of M_X, then M_C is the electromagnetic mass of M_X.

$$\left(\frac{M_X}{M_C}\right)^2 \cong \frac{4\pi\epsilon_0 G M_X^2}{e^2} \cong (X_E)^2 \tag{9}$$

With reference to the electron rest mass,

$$\left(\frac{M_X}{m_e}\right)^2 \cong X_E^2 \cdot \frac{e^2}{4\pi\epsilon_0 G m_e^2} \cong N^2 \tag{10}$$

Concept-4

If $\hbar$ is the quanta of the gravitational angular momentum, then the electromagnetic quanta can be expressed as $\left(\frac{\hbar}{X_E}\right)$. Thus the ratio,

$$\left(\frac{\hbar}{X_E}\right) \div \left(\frac{e^2}{4\pi\epsilon_0 c}\right) \cong (X_E\alpha)^{-1} \cong 0.464433353 \cong \sin\theta_W \tag{11}$$

where $\sin\theta_W$ is very close to the weak mixing angle

Concept-5

In modified quark SUSY [25], if Q_f is the mass of quark fermion and Q_b is the mass of quark boson, then

$$\frac{m_f}{m_b} \cong \Psi \cong 2.2627062 \tag{12}$$

and $\left(1-\frac{1}{\Psi}\right)Q_f$ represents the effective fermion mass. The number Ψ can be fitted with the following empirical relation

$$\Psi^2 \ln\left(1+\sin^2\theta_W\right) \cong 1 \tag{13}$$

With this idea super symmetry can be observed in the strong interactions [25] and can also be observed in the electroweak interactions [26-28].

Concept-6

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

$$F_C \cong \left(\frac{c^4}{G}\right) \cong 1.21026 \times 10^{44} \text{ newton} \tag{14}$$

It can be considered as the upper limit of the string tension. In its inverse form it appears in Einstein's theory of gravitation as $\frac{8\pi G}{c^4}$. It has multiple applications in Black hole physics and Planck scale physics [29]. It has to be measured either from the experiments or from the cosmic and astronomical observations.

Concept-7

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.

$$\frac{F_C}{F_W} \cong N^2 \cong \frac{\text{upper limit of classical force}}{\text{nuclear weak force magnitude}} \tag{15}$$

Thus the proposed weak force magnitude is $F_W \cong \frac{c^4}{N^2 G} \cong 3.33715 \times 10^{-4}$ newton and can be considered as the characteristic nuclear weak string tension. It can be measured in the particle accelerators.

2 The characteristic nuclear radii

2.1 The characteristic nuclear charge radius

If $H_0 \cong 69.54$ Km/sec/Mpc, R_S is the characteristic radius of nucleus, it is noticed that,

$$R_S \cong \left(\frac{m_p}{M_X}\right)^2 \frac{c}{H_0} \cong 1.2368 \times 10^{-15} \text{ m} \tag{16}$$

where m_p is the proton rest mass. This can be compared with characteristic radius of the nucleus and the strong interaction range [30].

2.2 Scattering distance between electron and the nucleus

If $R_S \cong 1.21$ to 1.22 fm is the minimum scattering distance between electron and the nucleus, it is noticed that,

$$R_S \cong \left(\frac{\hbar c}{G\left(M_X\right)^2}\right) \cdot \left(\frac{\hbar c}{G m_e^2}\right) \cdot \frac{2Gm_e}{c^2} \cong 1.21565 \times 10^{-15} \text{ m} \tag{17}$$

Here M_X is the molar electron mass. Here it is very interesting to consider the role of the Schwarzschild radius of the 'electron mass' . Thus the two macroscopic physical constants N and G can be expressed in the following way.

$$N \cong \sqrt{\frac{2\hbar^2}{G m_e^3 R_S}} \tag{18}$$

$$G \cong \frac{2\hbar^2}{(M_X)^2 m_e R_S} \tag{19}$$

In this way, either the Avogadro number or the gravitational constant can be obtained. Combining the relations (16) and (17) and if $H_0 \cong 69.54$ Km/sec/Mpc, it is noticed that,

$$\frac{\hbar c}{Gm_p\sqrt{M_0 m_e}} \cong 0.991415 \tag{20}$$

Surprisingly this ratio is close to unity! How to interpret this ratio? From this relation it can be suggested that, along with the cosmic variable, H_0, in the atomic and nuclear physics, there exists one variable. In the physics history, it was suggested that, gravitational constant and the speed of light were cosmic variables. In our published paper [31] and accepted paper [32] it was assumed that, the reduced Planck's constant, the Bohr radius, the fine structure ratio were cosmic variables. In our another accepted paper [33] it was assumed that, proton mass and the proton radius were cosmic variables. Any how this is a very sensitive case and has to be discussed in depth. But it is clear that, on the cosmological time scale, there exists one variable physical quantity in the presently believed atomic and nuclear physical constants. 'Rate of change' in its magnitude may be a measure of the present cosmic acceleration. Thus independent of the cosmic red shift and CMBR observations, from the atomic and nuclear physics, cosmic acceleration can be verified. Based on the above coincidence, magnitude of the present Hubble's constant can be expressed as

$$H_0 \cong \frac{Gm_p^2 m_e c}{2\hbar^2} \cong 70.75 \text{ Km/sec/Mpc} \tag{21}$$

2.3 To fit the radius of proton

Let R_p be the radius of proton. It is noticed that,

$$R_p \cong \frac{M_X}{m_p} \cdot \frac{2GM_C}{c^2} \cong 9.0566 \times 10^{-16} \text{ m} \tag{22}$$

This obtained magnitude can be compared with the rms charge radius of the proton [34]. With different experimental methods its magnitude varies from 0.84184(67) fm to 0.895(18) fm. Here also it is very interesting to consider the role of the Schwarzschild radius of M_C. This type of coincidence can not be ignored in the unification scheme. Here the strange observation is: the ratio $\frac{M_X}{m_p}$. Please note that mass nature in both of the cases is the assumed 'gravitational mass' only. But the very strange observation is $\frac{2GM_C}{c^2}$. Here in this expression, M_C is playing a key role instead of M_X. But M_C is the assumed electromagnetic mass of M_X. If this logic is having any sense, then similar to M_C, 'electromagnetic mass of the proton' must play a strong role in nuclear physics. In this direction, in the following subsection, an attempt is made.

2.4 Strong interaction range - a cosmological fitting

Considering the above coincidences it can be suggested that, there exists a strong connection in between modern cosmology and the nucleus. Electromagnetic mass of proton is $m_{pe} \cong \left(\frac{m_p}{X_E}\right) \cong 5.66874 \times 10^{-30}$ Kg. With this mass unit, we noticed two very strange observations. They are

$$R_{S1} \cong \frac{e^2}{4\pi\varepsilon_0 m_{pe} c^2} \cong 4.5283 \times 10^{-16} \text{ m} \tag{23}$$

$$R_{S2} \cong \frac{2G\sqrt{M_0 m_{pe}}}{c^2} \cong 1.0493 \times 10^{-15} \text{ m} \tag{24}$$

where $H_0 \cong 70.75$ Km/sec/Mpc and $M_0 \cong 8.80434 \times 10^{52}$ Kg. Here R_{S1} represents the potential radius of m_{pe} having a charge e and R_{S2} represents the Schwarzschild radius of $\sqrt{M_0 m_{pe}}$. How to understand these radii! Here the very peculiar and careful observation is

$$R_{S2} \cong \frac{2G\sqrt{M_0 m_{pe}}}{c^2} \cong \sqrt{\left(\frac{2GM_0}{c^2}\right)\left(\frac{2Gm_{pe}}{c^2}\right)} \cong 1.0493 \times 10^{-15} \text{ m} \tag{25}$$

In this relation, $\frac{2GM_0}{c^2}$ is the Schwarzschild radius of the Hubble mass! It means, from unification point of view [10,11], if the above relation (24) or (25) receives any significance, then it can be suggested that, in the flat universe, for any observer - with in a radius of $\left(\frac{c}{H_0}\right)$, the Hubble volume may behave like a black hole [29].

Some scientists may say: this is a play with numbers. Some scientists may say: it seems to be a fun. Some scientists may say: it is very interesting. Some scientists say: nobody understands Mach's principle this way. Here, the fundamental question to be answered is - if the atom (and therefore all material rulers) expands, in what relation should the cosmic expansion then be measured? Answer is very simple. **If the universe is really accelerating, based on the galactic red shift, for the observer - the receding and accelerating galaxy must show a continuous increase in its red shift** [29]. There is no such evidence. If we do not yet know whether the universe is spatially closed or open, then the idea of Hubble mass can be used as a tool in cosmology and unification. Considering the particle and event horizon concepts, where ever we go in the flat universe, for the observer, Hubble volume is the only observable/workable volume. Hence where ever we go in the universe, Hubble mass plays the role. It is very close to the Mach's idea of distance cosmic back ground. It seems to be a quantitative description to the Mach's principle. Any how what ever may be their physical meaning, it is sure that these relations will help in understanding the characteristic properties of strong interaction, unification, cosmic acceleration and Mach's principle.

3 Magnetic moments of the nucleon

1. If $(\alpha X_E)^{-1} \cong \sin\theta_W$, magnetic moment of electron can be expressed as

$$\mu_e \cong \frac{1}{2}\sin\theta_W \cdot ec \cdot \sqrt{\frac{e^2}{4\pi\varepsilon_0 F_W}} \cong 9.274 \times 10^{-24} \text{ J/tesla} \tag{26}$$

2. It can be suggested that electron's magnetic moment is due to the nuclear weak force. Similarly magnetic moment of proton is due to the nuclear strong force and is close to

$$\mu_p \cong \frac{1}{2}\sin\theta_W \cdot ec \cdot \sqrt{\frac{e^2}{4\pi\varepsilon_0 F_S}} \tag{27}$$

where $R_0 \cong 1.21565$ fm and $F_S \cong \frac{e^2}{4\pi\varepsilon_0 R_0^2} \cong 156.115$ newton is the strong force magnitude. Thus

$$\mu_p \cong \frac{1}{2}\sin\theta_W \cdot ec \cdot R_0 \cong 1.356 \times 10^{-26} \text{ J/tesla} \tag{28}$$

3. If proton and neutron are the the two quantum states of the nucleon, by considering the radius of proton R_p, magnetic moment of neutron can be fitted as

$$\mu_n \cong \frac{1}{2}\sin\theta_W \cdot ec \cdot R_p \cong 9.782 \times 10^{-27} \text{ J/tesla} \tag{29}$$

4 Basic ideas in 'modified' quark super symmetry

Till today there is no reason for the question: why there exists 6 individual quarks? Till today no experiment reported a free fractional charge quark. Authors humble opinion is nuclear charge (either positive or negative) constitutes 6 different flavours and each flavour holds certain mass. Charged flavour 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 flavours and each flavour is a container for certain matter. If charged matter rests in a fermionic container it is 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? and why and how there exists a boson? Here interesting thing is that if 6 flavours are existing with 6 different masses then a single charge can have one or two or more flavours simultaneously. Since charge is a common property, mass of the multiple flavour charge seems to be the geometric mean of the mass of each flavour. If charge with flavour is called as a quark then charge with multi flavours can be called as a hybrid quark. Hybrid quark generates a multi flavour baryon. It is a property of the strong interaction space - time - charge. This is just like different tastes or different smells of matter. Important consequence of this idea is that- for generating a baryon there is no need to couple 3 fractional charge quarks.

1. There exists nature friendly integral charge quark fermions.
2. For every integral charge quark fermion there exists a corresponding integral charge quark boson. Quark fermion and quark boson mass ratio is close to 2.2627.
3. There exists integral charged massive quark fermi-gluons and integral charged massive quark boso-gluons. (Fermi-gluon means massive gluons having fermion behaviour and boso-gluon means massive gluons having boson behaviour. Quark femi-gluon can be called as the 'quark baryon' and quark boso-gluon can be called as 'quark meson').
4. Quark fermi-gluon or quark baryon masses can be expressed as $Q_F c^2 \cong 0.2314 \left[M_{Hf}^2 \times Q_f\right]^{\frac{1}{3}} c^2$ and Quark boso-gluon or quark meson masses can be expressed as $Q_M c^2 \cong 0.2314 \left[M_{Hb}^2 \times Q_b\right]^{\frac{1}{3}} c^2$ where Q_f and Q_b are the rest masses of quark fermion and quark boson respectively and M_{Hf} and M_{Hb} are the Higgs charged fermion and Higgs charged boson respectively.
5. $Q_{ef} \cong Q_f - Q_b \cong \left(1 - \frac{1}{\Psi}\right) Q_f$ acts as the effective quark fermion. Effective quark baryon mass can be expressed as $Q_E c^2 \cong 0.2314 \left[M_{Hf}^2 \times Q_{ef}\right]^{\frac{1}{3}} c^2$. These effective quark baryons play a vital role in fitting the unstable baryon masses. Quark meson masses play a vital role in fitting the unstable meson masses.
6. Characteristic nuclear fermion is 938.272 MeV and its corresponding nuclear boson is $\frac{938.272}{\Psi} \cong 414.67$ MeV. This boson couples with the light quark bosons or light quark mesons and generates neutral ground states. Thus it is the mother of presently believed strange mesons like 493, 548, 1020 MeV and 783, 890 MeV etc.
7. Charged ground state baryon rest energy is $(Q_{E1} Q_{E2})^{\frac{1}{2}} c^2$ or $\left(Q_{E1} Q_{E2}^2\right)^{\frac{1}{3}} c^2$ or $(Q_{E1} Q_{E2} Q_{E3})^{\frac{1}{3}} c^2$ where Q_{E1}, Q_{E2}, and Q_{E3} represents any three effective quark baryons. '**Integral charge light quark bosons**' in one or two numbers couples with the ground or excited **effective quark baryons** and generates **doublets and triplets**. This is just like 'absorption of photons by the electron'.
8. Rest energy of nucleon is close to $\left(\frac{2 U_F D_F}{U_F + D_F}\right) c^2 \cong 940.02$ MeV and nucleon rest energy difference is close to $(m_n - m_p) c^2 \cong \sin^2 \theta_W \cdot \left(\frac{2 U_f D_f}{U_f + D_f}\right) c^2 \cong 1.29623$ MeV.
9. **Only oppositely charged quark mesons couples together to form a neutral meson. No two quark fermions couples together to form a meson**. Neutral ground state meson rest energy is close to $(Q_{M1} + Q_{M2}) c^2$ where Q_{M1} and Q_{M2} represents any two quark mesons.
10. Fine rotational levels of any ground state energy $m_x c^2$ can be expressed as, if n =1,2,3..., and $I = n(n+1)$, $\left(mc^2\right)_I \cong [I]^{\frac{1}{4}} m_x c^2$ and $\left(mc^2\right)_{I/2} \cong \left[\frac{I}{2}\right]^{\frac{1}{4}} m_x c^2$. Super fine rotational levels can be obtained as $\left(mc^2\right)_I \cong [I]^{\frac{1}{12}} m_x c^2$ and $\left(mc^2\right)_{I/2} \cong \left[\frac{I}{2}\right]^{\frac{1}{12}} m_x c^2$.

4.1 To fit the muon and tau rest masses

Using X_E charged muon and tau masses [35] were fitted in the following way.

$$m_l c^2 \approx \frac{2}{3} \left[a_c^3 + \left(n^2 X_E\right)^n a_a^3\right]^{\frac{1}{3}} \tag{30}$$

n	Obt. Lep. energy (MeV)	Exp. Lep. energy (MeV)
0	Defined	0.510998910(13)
1	105.951	105.6583668(38)
2	1777.384	1776.99(29)

Table 1: Fitting of charged lepton rest masses.

where a_c and a_a are the coulombic and asymmetric energy coefficients of the semi empirical mass formula and $n = 0, 1, 2$. This is an approximate relation. Qualitatively this expression is connected with β decay. Accuracy can be improved with the following relation.

$$\text{If } \mathrm{E_W} \cong \sqrt{\frac{\mathrm{e^2 F_W}}{4\pi\epsilon_0}} \cong \frac{\mathrm{m_e c^2}}{\mathrm{X_E}} \cong 1.731843735 \times 10^{-3} \text{ MeV} \tag{31}$$

$$m_l c^2 \cong \left[X_E^3 + \left(n^2 X_E\right)^n \sqrt{N}\right]^{\frac{1}{3}} \; E_W \tag{32}$$

where $n = 0, 1, 2$.

If it is true that weak decay is due to weak nuclear force, then $\left(\frac{1}{N^2}\right)\frac{c^4}{G} \cong F_W$ can be considered as the characteristic weak force magnitude. Please refer the published papers for the mystery of electro weak bosons and the Higgs boson [25,26]. Please see table-1.

4.2 To correlate the electron, muon, proton and the charged pion rest masses

From the above table-1, if $m_\mu c^2 \cong 105.95$ MeV, surprisingly it is noticed that,

$$m_p c^2 \cong \frac{1}{\alpha} \cdot \left(\sqrt{m_\mu m_e} - m_e\right) \cong 938.29 \text{ MeV} \tag{33}$$

Based on the proposed SUSY, it is also noticed that

$$\left(m_\pi c^2\right)^{\pm} \cong \frac{1}{\Psi} \cdot \sqrt{m_\mu m_p} \cong 139.34 \text{ MeV} \tag{34}$$

These two obtained mass units can be compared with the proton and the charged pion rest masses respectively. In a unified scheme these interesting observations can not be ignored.

4.3 Nucleons, up & down quarks and the strong coupling constant

It our earlier published papers [25,26] it was also defined that

$$\frac{m_u c^2}{m_e c^2} \cong e^{X_E \alpha} \tag{35}$$

where m_u is the up quark rest mass and m_d is the down quark rest mass respectively. In our earlier papers, suggested up quark mass is 4.4 MeV and down quark mass is 9.476 MeV. With these magnitudes it is noticed that,

$$\left(m_n - m_p\right) c^2 \cong \ln\left(\frac{\sqrt{m_u m_d}}{m_e}\right) \cdot m_e c^2 \tag{36}$$

Here lhs =1.2933 MeV and rhs= 1.2963 MeV.It is also noticed that

$$\left(\frac{\sqrt{m_u m_d}}{m_e}\right) \cong \frac{1}{2}\sqrt{\frac{G\left(M_X\right)^2}{\hbar c}} \cong 12.60271 \tag{37}$$

With reference to the strong coupling constant α_s - it is also noticed that [19],

$$\left(\frac{1}{\alpha} + \frac{1}{\alpha_s}\right)\sqrt{m_u m_d}\, c^2 \cong 940 \text{ MeV} \tag{38}$$

$$\frac{\sqrt{m_u m_d}\; c^2}{\left(m_n - m_p\right)\; c^2} \cong \ln\left(\frac{1}{\alpha} + \frac{1}{\alpha_s}\right) \tag{39}$$

4.4 To fit the strong coupling constant

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 does 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, 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 [36] 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 $\alpha_s \cong 0.1139 + 0.002 = 0.1159$. It can be fitted or defined in the following way.

$$X_S \cong \frac{1}{\alpha_s} \cong \ln\sqrt{\frac{4\pi\epsilon_0 G\left(M_X\right)^2}{e^2}} + \ln\sqrt{\frac{G\left(M_X\right)^2}{\hbar c}} \tag{40}$$

Thus $X_S \cong 8.914239916$.

$$\text{simply,}\ \ \frac{1}{\alpha_{\mathrm{s}}} \cong \mathrm{X_S} \cong \ln\left(\mathrm{X_E^2}\sqrt{\alpha}\right) \cong \frac{1}{0.112180063} \tag{41}$$

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 [25]. With this magnitude it is noticed that

$$m_n c^2 \cong \left(\frac{1}{\alpha} + \frac{1}{\alpha_s}\right)\sqrt{m_u m_d}\, c^2 - \frac{m_u}{m_d}\left(\frac{2 m_u m_d}{m_u + m_d}\right) c^2 \cong 939.6 \text{ MeV} \tag{42}$$

$$m_p c^2 \cong \left(\frac{1}{\alpha} + \frac{1}{\alpha_s}\right)\sqrt{m_u m_d}\, c^2 - \sqrt{\frac{m_u}{m_d}}\left(\frac{2 m_u m_d}{m_u + m_d}\right) c^2 \cong 938.30 \text{ MeV} \tag{43}$$

where $\left(\frac{1}{\alpha} + \frac{1}{\alpha_s}\right)\sqrt{m_u m_d}\, c^2 \cong 942.393$ MeV.

5 Integral charge quark fermions and their SUSY bosons

In the previous papers [25] authors suggested that up, strange and bottom quarks are in geometric series. Similarly down, charm and top quarks are in another geometric series. Obtained quark fermion masses can be compared with the current estimates. Up and down fermion masses can be given as

$$u_f c^2 \cong e^{\alpha X_E} \times m_e c^2 \cong 4.4 \text{ MeV} \tag{44}$$

where $X_E \cong \sqrt{\frac{4\pi\varepsilon_0 G(M_X)^2}{e^2}} \cong 295.0606338$ and α is the fine structure ratio.

$$d_f c^2 \cong \alpha X_E \times u_f c^2 \cong 9.4755 \text{ MeV} \tag{45}$$

Here, $m_e c^2$= rest energy of electron, α= fine structure ratio , X_E = proposed lepton mass generator. It is very interesting to note that

$$\frac{\text{Down fermion mass}}{\text{Up fermion mass}} \cong \frac{d_f}{u_f} \cong \alpha X_E \cong \frac{1}{\sin\theta_W} \tag{46}$$

In this way $\sin\theta_W$ can be related with up and down quark mass ratio. Proposed USB geometric ratio is

$$g_U \cong \left[\alpha X_E \,\frac{\alpha X_E + 1}{\alpha X_E - 1}\right]^2 \cong 34.66294 \tag{47}$$

If DCT series is the second generation series, its geometric ratio is

$$g_D \cong \left[2\alpha X_E \,\frac{\alpha X_E + 1}{\alpha X_E - 1}\right]^2 \cong 138.651754 \tag{48}$$

Quark	Q_f **(MeV)**	Q_b**(MeV)**
Up	4.401	1.945
Down	9.4755	4.188
Strange	152.5427	67.416
Charm	1313.796	580.63
Bottom	5287.579	2336.839
Top	**182160.18**	**80505.46**

Table 2: Fitting of quark fermion and quark boson masses.

And

$$\frac{g_D}{g_U} \cong \frac{\text{DCT geometric ratio}}{\text{USB geometric ratio}} \cong 4. \tag{49}$$

$$\text{Quark boson mass } = Q_b \cong \frac{\text{Quark fermion mass}}{\Psi} \cong \frac{Q_f}{\Psi} \tag{50}$$

Please see the following table-2 for the obtained quark 'fermion' and 'boson' masses. The observed baryon and meson charge-mass spectrum can be generated from these mass units. **Strange quark boson pair generates the neutral pion of rest energy 134.83 MeV**. Obtained top quark boson rest energy is 80505 MeV and is very close to the observed W boson rest energy $80.450 \pm$ 0.058 GeV and 80.392 ± 0.039 GeV. Please refer M. Yao et al [35] recommended PDG data. Really this is a great coincidence and support for the proposed new idea of "fermion-boson" unification scheme. This strongly supports super symmetry with small modifications.

5.1 Beta decay, Higg's charged fermion and its boson

It is well established that in Beta decay electron is instantaneously created from neutron and this nuclear weak force is mediated by W and Z bosons. If W boson is really the SUSY partner of top quark then the role of W boson in weak decay seems to be nothing. Its role is taken up by the newly proposed Higgs charged boson of rest energy close to 45.6 GeV. Its rest energy is equal to half the rest energy of neutral Z boson. Semi empirically it is noticed that

$$\frac{m_e c^2}{F_W R_0} \cong \frac{\Psi M_{Hb}}{m_e} \tag{51}$$

Here, M_{Hb} is the rest mass of charged Higgs boson and ΨM_{Hb} is its fermionic form. Ψ is a unified SUSY fermion and boson mass ratio =2.2627. m_e is the rest mass of electron, R_S is nuclear characteristic charge radius. Mass of ΨM_{Hb} or M_{Hf} can be expressed as

$$M_{Hf} c^2 \cong \left(\frac{m_e c^2}{F_W R_S}\right) \cdot m_e c^2 \tag{52}$$

and

$$M_{Hb} c^2 \cong \frac{M_{Hf} c^2}{\Psi} \cong \frac{1}{\Psi} \cdot \left(\frac{m_e c^2}{F_W R_S}\right) \cdot m_e c^2 \tag{53}$$

Here accuracy depends on R_S. From relation (17) it was noticed that

$$\hbar \cong \sqrt{\frac{G \left(M_X\right)^2 m_e R_S}{2}} \tag{54}$$

$$M_{Hf} c^2 \cong \frac{1}{2} \cdot \left(\frac{G \left(M_X\right)^2}{\hbar c}\right)^2 \cdot m_e c^2 \cong 103125.417 \text{ MeV} \tag{55}$$

$$M_{Hb} c^2 \cong \frac{M_{Hf} c^2}{\Psi} \cong \frac{1}{2} \cdot \left(\frac{G \left(M_X\right)^2}{\hbar c}\right)^2 \cdot \frac{m_e c^2}{\Psi} \cong 45576.1467 \text{ MeV} \tag{56}$$

5.2 Rest energy of the neutral Z boson

From above estimation, neutral Z boson rest energy can be given as

$$m_Z c^2 \cong \left(M_{Hb} c^2\right)^{\pm} + \left(M_{Hb} c^2\right)^{\mp} \cong 2M_{Hb} c^2 \cong 91152.293 \text{ MeV} \tag{57}$$

$$m_Z c^2 \cong \left(\frac{G\left(M_X\right)^2}{\hbar c}\right)^2 \cdot \frac{m_e c^2}{\Psi} \cong 91152.293 \text{ MeV} \tag{58}$$

This obtained value can be compared with the experimental rest energy of Z boson = 91187.621 MeV. Please refer M. Yao et al recommended PDG data [35].

5.3 Recently discovered boson of rest energy 126 GeV

Close to the predicted rest energy of Higgs boson, recently a new boson of rest energy 124 to 160 GeV was reported. Surprising thing is that its existence is not matching with the current theoretical predictions. In this critical situation, with the help of strong nuclear gravity and modified super symmetry concepts, authors made an attempt to understand the origin of this new boson[26]. In our previous paper [25] it was suggested that: W boson is the super symmetric boson of the top quark fermion and the charged Higgs boson pair generates the neutralized Z boson.

It is noticed that Higgs charged boson and top quark boson couples together to form a new neutral boson of rest energy 126.0 GeV. This is a very interesting observation. Like Z boson it can decay into 2 charged particles.

$$\left(M_{Hb} c^2\right)^{\pm} + \left(m_W c^2\right)^{\mp} \cong 126.0 \text{ GeV}. \tag{59}$$

6 Quark baryon and quark meson masses with SUSY Higg's charged particle

In our earlier published paper it it was assumed that [25], if Q_F is the quark baryon rest mass

$$Q_F c^2 \cong \left[M_{Gf}^2 \cdot Q_f\right]^{\frac{1}{3}} c^2 \tag{60}$$

If Q_E is the quark effective baryon rest mass,

$$Q_E c^2 \cong \left[M_{Gf}^2 \cdot Q_{ef}\right]^{\frac{1}{3}} c^2 \tag{61}$$

If Q_M is the quark meson rest mass,

$$Q_M c^2 \cong \left[M_{Gb}^2 \cdot Q_b\right]^{\frac{1}{3}} c^2 \tag{62}$$

where $M_{Gf} c^2 \cong 11460$ MeV and its bosonic form $M_{Gb} c^2 \cong \frac{M_{Gf} c^2}{\Psi} \cong 5066$ MeV. With reference to the newly proposed Higgs charged fermion and boson, above relations can be expressed as

$$Q_F c^2 \cong x\left[M_{Hf}^2 \cdot Q_f\right]^{\frac{1}{3}} c^2 \tag{63}$$

$$Q_E c^2 \cong x\left[M_{Hf}^2 \cdot Q_{ef}\right]^{\frac{1}{3}} c^2 \tag{64}$$

$$Q_M c^2 \cong x\left[M_{Hb}^2 \cdot Q_b\right]^{\frac{1}{3}} c^2 \tag{65}$$

$$\text{where} \quad \mathrm{x} \cong \frac{1}{2\alpha\left(\mathrm{X_E}+1\right)} \cong 0.23143232 \tag{66}$$

Please see table-3 for the quark baryon rest energies and see table-4 for the quark meson rest energies.

6.1 Rest energy of the nucleon

From table-3 it is noticed that, nucleon mass is very close to the harmonic mean of the up baryon and down baryon masses.

$$\frac{2\left(u_F c^2\right)\left(d_F c^2\right)}{\left(u_F + d_F\right) c^2} \cong 940.06 \text{ MeV} \tag{67}$$

where $u_F c^2 \cong 834.04$ MeV and $d_F c^2 \cong 1076.97$ MeV. It is also noticed that,

$$\left(m_n - m_p\right) c^2 \cong \sin^2\theta_W \left[\frac{2\left(u_f c^2\right)\left(d_f c^2\right)}{\left(u_f + d_f\right) c^2}\right] \cong 1.2964 \text{ MeV} \tag{68}$$

where m_p and m_n are the rest masses of proton and neutron respectively.

7 To fit the semi empirical mass formula energy coefficients

The semi-empirical mass formula (SEMF) is used to approximate the mass and various other properties of an atomic nucleus [37,38]. As the name suggests, it is based partly on theory and partly on empirical measurements. The theory is based on the liquid drop model proposed by George Gamow and was first formulated in 1935 by German physicist Carl Friedrich von Weizscker. Based on the 'least squares fit', volume energy coefficient is $a_v = 15.78$ MeV, surface energy coefficient is $a_s = 18.34$ MeV, coulombic energy coefficient is $a_c = 0.71$ MeV, asymmetric energy coefficient is $a_a = 23.21$ MeV and pairing energy coefficient is $a_p = 12$ MeV. The semi empirical mass formula is

$$BE \cong Aa_v - A^{\frac{2}{3}} a_s - \frac{Z\left(Z-1\right)}{A^{\frac{1}{3}}} a_c - \frac{\left(A-2Z\right)^2}{A} a_a \pm \frac{1}{\sqrt{A}} a_p \tag{69}$$

In a unified approach it is noticed that, the energy coefficients are having strong inter-relation with the proton rest mass and the 'mole electron mass'. The interesting observations can be expressed in the following way.

7.1 The coulombic energy coefficient

It can be defined as [39],

$$a_c \cong \alpha \cdot \alpha_s \cdot m_p c^2 \cong 0.7681 \text{ MeV} \tag{70}$$

Ratio of the coulombic energy coefficient and the proton rest energy is close to the product of the fine structure ratio and the strong coupling constant.

7.2 The surface and volume energy coefficients

Surface energy coefficient can be defined as

$$a_s \cong \sqrt{\frac{G\left(M_X\right)^2}{\hbar c}} \cdot a_c \cong 19.36 \text{ MeV} \tag{71}$$

Quark	Q_f**(MeV)**	Q_F**(MeV)**	Q_{ef}**(MeV)**	Q_E**(MeV)**
Up	4.401	834.04	2.456	686.66
Down	9.4755	1076.97	5.2878	886.67
Strange	152.5427	2719.35	85.127	2238.84
Charm	1313.796	5574.13	733.165	4589.18
Bottom	5287.579	8866.53	2950.74	7299.81
Top	**182160.18**	28850.43	101654.72	23752.56

Table 3: Fitting of quark baryon and quark effective baryon rest energies.

Quark	Q_b**(MeV)**	Q_M**(MeV)**
Up	1.945	368.6
Down	4.188	475.98
Strange	67.416	1201.81
Charm	580.63	2463.48
Bottom	2336.839	3918.55
Top	**80505.46**	**12750.41**

Table 4: Fitting of quark boson and quark meson rest energies.

Z	**A**	$\mathbf{(BE)_c}$ **in MeV**	$\mathbf{(BE)_m}$ **in MeV**	**%Error**
26	56	492.60	492.254	-0.0713
28	62	547.08	545.259	-0.335
34	84	728.29	727.341	-0.131
50	118	1007.46	1004.950	-0.250
60	142	1183.64	1185.145	0.127
79	197	1554.82	1559.40	0.293
82	208	1625.22	1636.44	0.686
92	238	1803.12	1801.693	-0.0795

Table 5: **SEMF binding energy with the proposed energy coefficients**

Volume energy coefficient can be defined as

$$a_v \cong \sqrt{\frac{G\left(M_X\right)^2}{\sqrt{2}\hbar c}} \cdot a_c \cong 16.28 \text{ MeV} \tag{72}$$

$$\text{Thus,} \quad \frac{\mathrm{a_s}}{\mathrm{a_v}} \cong 2^{\frac{1}{4}} \tag{73}$$

7.3 The asymmetry and pairing energy coefficients

Asymmetry energy coefficient can be defined as

$$a_a \cong \frac{2}{3}\left(a_v + a_s\right) \cong 23.76 \text{ MeV} \tag{74}$$

Pairing energy coefficient is close to

$$a_p \cong \frac{1}{3}\left(a_v + a_s\right) \cong 11.88 \text{ MeV} \tag{75}$$

$$\text{Thus,} \quad \mathrm{a_v + a_s \cong a_a + a_p} \cong 35.64 \text{ MeV} \tag{76}$$

In table-5 considering the magic numbers, within the range of $(Z = 26; A = 56)$ to $(Z = 92; A = 238)$ nuclear binding energy is calculated and compared with the measured binding energy [40]. Column-3 represents the calculated binding energy and column-4 represents the measured binding energy. If this procedure is found to be true and valid then with a suitable fitting procedure qualitatively and quantitatively magnitudes of the proposed SEMF binding energy coefficients can be refined.

7.4 Proton-nucleon stability

It is noticed that

$$\frac{A_s}{2Z} \cong 1 + 2Z\left(\frac{a_c}{a_s}\right)^2 \cong 1 + 2Z\left(\frac{\hbar c}{G\left(M_X\right)^2}\right) \tag{77}$$

where A_s is the stable mass number of Z. This is a direct relation. Assuming the proton number Z, in general, for all atoms, lower stability can be fitted directly with the following relation [37].

$$A_s \cong 2Z\left[1+2Z\left(\frac{a_c}{a_s}\right)^2\right] \cong 2Z+Z^2 * 0.0063 \tag{78}$$

If $Z=21$, $A_s \cong 44.78$; if $Z=29$, $A_s \cong 63.29$; if $Z=47$, $A_s \cong 107.91$; if $Z=53$, $A_s \cong 123.68$; if $Z=60$, $A_s \cong 142.66$; if $Z=79$, $A_s \cong 197.29$; if $Z=83$, $A_s \cong 209.37$; if $Z=92$, $A_s \cong 237.29$;

Stable super heavy elements can be predicted with this relation. In between $Z=30$ to $Z=60$ obtained A_s is lower compared to the actual A_s. It is noticed that, upper stability in light and medium atoms upto $Z \approx 56$ can be fitted with the following relation.

$$A_s \cong 2Z\left[1+2Z\left(\left(\frac{a_c}{a_s}\right)^2+\left(\frac{a_c}{a_a+a_p}\right)^2\right)\right] \cong 2Z+Z^2 * 0.0082 \tag{79}$$

From this relation for $Z=56$, obtained upper $A_s \cong 137.7$. Note that, for $Z=56$, actual stable $A_s \cong 137 \cong \frac{1}{\alpha}$ where α is the fine structure ratio. This seems to be a nice and interesting coincidence. In between 0.0063 and 0.0082, for light and medium atoms upto $Z \approx 56$ or $A_s \approx 137$, mean stability can be fitted with the following relation.

$$A_s \cong 2Z+Z^2 * 0.0072 \tag{80}$$

Surprisingly it is noticed that, in this relation, $0.0072 \approx \alpha \cong 0.0073$. Thus upto $Z \cong 56$ or $A_s \approx 137$, mean stability can be expressed as

$$A_s \approx 2Z+\left(Z^2\alpha\right) \tag{81}$$

7.5 Nuclear binding energy with 2 terms and only one energy constant

Nuclear binding energy can be fitted with 2 terms or 4 factors with $a_c \cong 0.7681$ MeV as the single energy constant [41,42]. First term can be expressed as

$$T_1 \cong (f)(A+1)\ln\left[(A+1)X_S\right]a_c \tag{82}$$

where $f \cong 1+\frac{2Z}{A_s} \leq 2.0$ and $X_S \cong 8.91424$ is the strong coupling constant.
Second term can be expressed as

$$T_2 \cong \left[\frac{A^2+\left(f.Z^2\right)}{X_S^2}\right]a_c \tag{83}$$

Close to the stable mass number A_s,

$$B.E = T_1 - T_2 \tag{84}$$

Please see the following data.
$Z=2$ & $A=4$, $B.E \cong 28.93$ MeV; $Z=10$ & $A=20$, $B.E \cong 160.44$ MeV;
$Z=26$ & $A=56$, $B.E \cong 482.06$ MeV; $Z=50$ & $A=118$, $B.E \cong 1007.35$ MeV;
$Z=79$ & $A=197$, $B.E \cong 1563.72$ MeV; $Z=82$ & $A=208$, $B.E \cong 1634.76$ MeV;
$Z=92$ & $A=238$, $B.E \cong 1805.15$ MeV;
Above 2 terms can be put into 4 factors as

$$B.E \cong \left[2-\frac{A}{2Z}\right](f)(A+1)\ln\left[(A+1)X_S\right]a_c \tag{85}$$

With this relation,
$Z=2$ & $A=4$, $B.E \cong 29.07$ MeV; $Z=10$ & $A=20$, $B.E \cong 160.98$ MeV;
$Z=26$ & $A=56$, $B.E \cong 484.56$ MeV; $Z=50$ & $A=118$, $B.E \cong 973.32$ MeV;
$Z=79$ & $A=197$, $B.E \cong 1542.1$ MeV; $Z=82$ & $A=208$, $B.E \cong 1587.52$ MeV;
$Z=92$ & $A=238$, $B.E \cong 1764.8$ MeV;
These relations can be can be considered for further research and analysis positively.

Conclusions

Searching, collecting, sorting and compiling the cosmic code is an essential part of unification. In this attempt the above proposed observations and concepts can be given a chance. Further research and analysis in this new direction and the experimental data may reveal the facts.

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