A Brief Report On Hubble Volume, Molar Electron Mass And The Four Cosmological Interactions

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Abstract Basic idea is - current cosmological changes may be reflected in any atom. At any given cosmic time, 'Hubble length' can be considered as the gravitational or electromagnetic interaction range. Some cosmologists use the term 'Hubble volume' to refer to the volume of the observable universe. With reference to the Mach's principle and Hubble volume, at any cosmic time, if 'Hubble mass' is the product of cosmic 'critical density' and the 'Hubble volume', then it can be suggested that, each and every point in the free space is influenced by the Hubble mass. Clearly speaking, with Hubble volume and Hubble mass: quantum physics, nuclear physics and cosmic physics can be studied in a unified manner. In this new direction authors noticed some interesting coincidences. With reference to the present fine structure ratio, present value of Hubble's constant is 69.53 km/sec/Mpc or 71.75 km/sec/Mpc.

Keywords Hubble length, Hubble volume, Mach's principle, Fine structure ratio, Avogadro number, Four cosmological interactions, SUSY.

Introduction

In 1998, published observations of Type Ia supernovae by the High-z Supernova Search Team followed in 1999 by the Supernova Cosmology Project suggested that the expansion of the universe is accelerating [1]. According to the WMAP seven-year analysis, universe constitutes 72.8% dark energy, 22.7% dark matter and 4.6% ordinary matter. Authors would like to ask the questions: What are the important applications of the 72.8% dark energy or 22.7% dark matter in the other important fundamental areas of physics (like unification of the fundamental interactions)? What is the role of dark matter or dark energy in understanding the atom and the atomic nucleus?

Please note that, when it was proposed in 1948, the CMBR idea was never accepted by the science community. In 1965, this fantastic concept was realized serendipitously. The very surprising thing was that the experimentalists were not aware of what they discovered! Up to 1998, people believed in cosmic deceleration. By 2000, it was a shocking news to many cosmologists that, the universe is accelerating. Please note that, still some scientists argue that, the only indication for the existence of dark energy is observations of distance measurements and associated redshifts. Cosmic microwave background anisotropies and baryon acoustic oscillations are only observations that redshifts are larger than expected from a 'dusty' Friedmann-Lemaitre universe and the local measured Hubble constant.

Here it is very important to note that, in reality no one measured the galaxy's receding speed! But it is the required primary measurement. Based on the Hubble's law, as a secondary or indirect measurement, receding galaxy's redshift is being measured. This is the normal practice and in support of that, galaxy's estimated distance is compared with other secondary methods! If the universe is really accelerating, based on the same Hubble's law, for the observer - the receding or accelerating galaxy must show a continuous increase in its red shift! Some says: instantaneously red shift cannot increase due to the limited photon speed. If cosmic acceleration began 5 billion years ago, then during its accelerated receding journey, the galaxy must show a continuous increase in red shift - whether the change is due to past accelerated receding or present accelerated receding. There is no such evidence. In this connection - the appropriate idea can be stated as follows: 1) 'Redshift' is a measure of expansion and 2) 'Rate of increase in red shift' is a measure of cosmic 'rate of expansion'. This idea can be supported by another simple concept: 1) 'Drop in cosmic temperature' is a measure of cosmic expansion and 2) 'Rate of decrease in cosmic temperature' is a measure of cosmic 'rate of expansion'.

For a cosmologist, there are only few parameters needed to describe the universe. All models are based on Einstein's theory of general relativity. The world models are characterized by two parameters: the current rate and the deceleration of the expansion. The first parameter is called the Hubble constant after Edwin Hubble [2]. The other parameter describes the change of the expansion and depends on the energy density and the curvature of the universe. The contributions to the density are expressed as fractions of the critical density. The expansion itself is typically measured by the redshift and is the ratio of the scale factor at two different times of the expansion. In 1947, Hubble suggested that [3]:

"*The red shifts are more easily interpreted as evidence of motion in the line of sight away from the earth – as evidence that the nebulae in all directions are rushing away from us and that the farther away they are, the faster they are receding. This interpretation lends itself directly to theories of expanding universe. The interpretation is not universally accepted, but even the most cautious of us admit that red shifts are evidence of either an expanding universe or of some hitherto unknown principle of nature*"

"*Attempts have been made to attain the necessary precision with the 100 inch, and the results appear to be significant. If they are valid, it seems likely that the red-shifts may not be due to an expanding universe, and much of the current speculation on the structure of the universe may require re-examination. The significant data, however, were necessarily obtained at the very limit of a single instrument, and there were no possible means of checking the results by independent evidence. Therefore the results must be accepted for the present as suggestive rather than definitive*".

"*We may predict with confidence that the 200 inch will tell us whether the red shifts must be accepted as evidence of a rapidly expanding universe, or attributed to some new principle in nature. Whatever may be the answer, the result may be welcomed as another major contribution to the exploration of the universe.*"

In physics history, for any new idea or observation or new model - at the very beginning – their existence was very doubtful. The best examples were : 1) Existence of atom 2) Existence of quantum of energy 3) Existence of integral nature of angular momentum 4) Existence of wave mechanics 5) Six quarks having fractional charge 6) Confirming the existence of muon/pion 7) Existence of Black holes 8) Black hole radiation 9) Einstein's cosmological Lambda term 10) Cosmic red shift 11) Discovery of CMBR and 12) Accelerating universe [4-11].

Note that, Einstein, more than any other physicist, untroubled by either quantum uncertainty or classical complexity, believed in the possibility of a complete, perhaps final, theory of everything. [12]. He also believed that the fundamental laws and principles that would embody such a theory would be simple, powerful and beautiful. Physicists are an ambitious lot, but Einstein was the most ambitious of all. His demands of a fundamental theory were extremely strong. *If a theory contained any arbitrary features or undetermined parameters then it was deficient, and the deficiency pointed the way to a deeper and more profound and more predictive theory. There should be no free parameters – no arbitrariness. According to his philosophy, electromagnetism must be unified with general relativity, so that one could not simply imagine that it did not exist. Furthermore, the existence of matter, the mass and the charge of the electron and the proton (the only elementary particles recognized back in the 1920s), were arbitrary features. One of the main goals of a unified theory should be to explain the existence and calculate the properties of matter.*

Current status of Mach's principle - Hubble volume

In theoretical physics, particularly in discussions of gravitation theories, Mach's principle [13] 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.

One of the main motivations behind formulating the general theory of relativity was to provide a mathematical description to the Mach's principle. However, soon after its formulation, it was realized that the theory does not follow Mach's principle. As the theoretical predictions were matching with the observations, Einstein believed that the theory was correct and did not make any farther attempt to reformulate the theory to explain Mach's principle. Later on, several attempts were made by different researchers to formulate the theory of gravity based on Mach's principle. However most of these theories remain unsuccessful to explain different physical phenomena. In the standard cosmology, 'Hubble volume' or 'Hubble sphere' is a spherical region of the Universe surrounding an observer beyond which objects recede from that observer at a rate greater than the speed of light due to the expansion of the Universe. The commoving radius of a Hubble sphere (known as the Hubble radius or the Hubble length) is, (c/H_0), where (c) is the speed of light and (H_0) is the Hubble constant. More generally, the term 'Hubble volume' can be applied to any region of space with a volume of the order of $(4\pi/3)(c/H_0)^3$. 'Hubble volume' can be considered as a key tool in cosmology and unification. Some cosmologists use the term 'Hubble volume' to refer to the volume of the observable universe. With reference to the Mach's principle and the Hubble volume, at any cosmic time, if 'Hubble mass' is the product of cosmic 'critical density' and the 'Hubble volume', then it can be suggested that, 1) Each and every point in the free space is influenced by the Hubble mass, 2) Hubble volume and Hubble mass play a vital role in understanding the properties of electromagnetic and nuclear interactions and 3) Hubble volume and Hubble mass play a key role in understanding the geometry of the universe. Thus in this paper an attempt is made to understand the basic unified concepts of 'electromagnetism', 'gravity' and 'strong interaction range' via the Hubble length, Hubble volume and Hubble mass [14,15].

The basic idea of unification is – 1) To minimize the number of physical constants and 2) To merge a group of different fundamental constants into one compound physical constant with appropriate interpretation. In this journey, the first step is to see the numerical coincidences, second step is to interpret the numerical coincidences and the third step is to synchronize the current interpretations and new interpretations. When the new interpretation disagrees with the current interpretation, generally with the help of emerging science and technology, discrepancies can be resolved with future observations and experiments. Mean while mathematical physics play a key role in understanding and analyzing the new and old interpretations. When the subject under consideration is very sensitive to human thoughts, observations and interpretations and when the subject under consideration is also related with large numbers, proposed accurate numerical coincidences and new interpretations may be given some consideration.

Semi empirical applications of Mach's principle, Hubble volume and Hubble mass

Note that till today quantitatively Mach's principle was not implemented successfully in cosmic and nuclear physics. If we do not yet know whether the universe is spatially closed or open, then the idea of 'Hubble volume' 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 volume plays the same role. It seems to be a quantitative description to the Mach's principle. 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 $R_0 \cong \left(c/H_0\right)$, mass of the cosmic Hubble volume is $M_0 \cong \frac{c^3}{2GH_0}$. For the time being let us call this mass as 'Hubble mass'. With this definition, apart from cosmology, Mach's principle can be given a fundamental unified significance in atomic, nuclear and particle physics! Here, as a point of curiosity, if one is willing to consider this mass as a characteristic mass of the universe, very easily, Planck scale, cosmology and particle physics can be studied in a unified manner. It depends only on our choice of scientific interest. If m_p is the rest mass of proton and m_e is the rest mass of electron, it is noticed that,

$$R_s \cong \frac{G\sqrt{M_0\sqrt{m_p m_e}}}{c^2} \cong (1.37 \text{ to } 1.39)\times 10^{-15} \text{ m} \quad (1)$$

where $H_0 \cong 70.4^{+1.3}_{-1.4}$ km/sec/Mpc [16-20]. In reality, this length is close to the observed strong interaction range or the characteristic nuclear unit radius [21,22]. With reference to the classical radius of electron,

$$\frac{2G\sqrt{M_0\sqrt{m_p m_e}}}{c^2} \cong \frac{e^2}{4\pi\epsilon_0 m_e c^2} \quad (2)$$

If M_p is the Planck mass and $R_0 \cong \left(c/H_0\right)$ is the gravitational and electromagnetic interaction range, it is noticed that,

$$\ln\left(\frac{m_e R_0^2}{M_P R_s^2}\right) \cong 137.2 \cong \frac{1}{\alpha}. \quad (3)$$

Now the fundamental question to be answered is – Is fine structure ratio – a cosmological variable. If it is possible, then the reduced Planck's constant also seems to be a cosmological variable. From relations (1) and (3) it is noticed that,

$$\ln\left(\sqrt{\frac{m_p}{M_0}}\cdot\frac{m_e R_0^2}{M_p R_p^2}\right) \cong \frac{1}{\alpha} \quad (4)$$

where $M_p \cong \sqrt{\frac{\hbar c}{G}}$ is the Planck mass, $R_p \cong \sqrt{\frac{G\hbar}{c^3}}$ is the Planck size and m_p is the proton rest mass. On re-arranging, to a great surprise it is noticed that

$$\frac{\hbar c}{G m_p \sqrt{M_0 m_e}} \cong 0.99753 \quad (5)$$

This ratio is very close to unity! From this relation it can be suggested that, along with the cosmic variable H_0, 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 atomic and nuclear physics, cosmic acceleration can be verified. Above relation can be expressed as

$$\hbar \cong \sqrt{\frac{M_0}{m_e}}\cdot\frac{G m_p m_e}{c} \cong 1.0572\times 10^{-34} \text{ J.sec} \quad (6)$$

With trial-error method it is also noticed that,

$$\hbar \cong \sqrt{\frac{N}{2}\cdot e^{\frac{1}{\alpha}}}\cdot\frac{G m_p m_e}{c} \cong 1.0637\times 10^{-34} \text{ J.sec} \quad (7)$$

where N is the Avogadro number [20]. This is another surprising coincidence. From relations (3) and (7) and with 'molar electron mass', it is noticed that,

$$\hbar \cong \left(\frac{2Gm_p}{c^2 R_p}\right)\cdot\left(m_e c R_0\right) \cong \frac{2Gm_p m_e}{R_p H_0} \tag{8}$$

where R_p is the 'rms charge radius' of proton [23]. With different experimental methods R_p magnitude varies from 0.84184(67) fm to 0.895(18) fm. This is another accurate relation that connects the universe and the atom. From these coincidences it is possible to guess that, both $(\hbar)$ and (α) are compound cosmological variable quantities. But the main problem is that – variation of $(\hbar)$ seems to be linear and variation of $(1/\alpha)$ seems to be natural logarithmic.

Cosmic Fine Structure Ratio and the reduced Planck's constant

In atomic and nuclear physics, the fine-structure ratio (α) is a fundamental physical constant, namely the coupling constant characterizing the strength of the electromagnetic interaction [19,20]. Being a dimensionless quantity, it has a constant numerical value in all systems of units. If $\rho_0 c^2$ is the present cosmic critical energy density and aT_0^4 is the present cosmic thermal energy density, it is noticed that,

$$\ln\sqrt{\frac{aT_0^4}{\rho_0 c^2}\cdot\frac{4\pi\epsilon_0 G M_0^2}{e^2}} \cong \left(\frac{1}{\alpha}\right) \tag{9}$$

At present, if H_0 is close to 71 km/sec/Mpc and $T_0 \cong 2.725\ {}^0K$, obtained value of $(1/\alpha)_0$ is 137.04773. Note that, from unification point of view, till today role of dark energy or dark matter is unclear and undecided. Their laboratory or physical existence is also not yet confirmed. In this critical situation this application can be considered as a key tool in particle cosmology. Note that large dimensionless constants and compound physical constants reflect an intrinsic property of nature. Above relation takes the following form.

$$\ln\sqrt{\frac{2\pi}{3}\cdot\frac{4\pi\epsilon_0\left(aT_0^4\right)c^4}{e^2 H_0^4}} \cong \left(\frac{1}{\alpha}\right)_0 \tag{10}$$

After simplification, it can be interpreted as follows. Total thermal energy in the present Hubble volume can be expressed as,

$$\left(E_T\right)_0 \cong aT_0^4\cdot\frac{4\pi}{3}\left(\frac{c}{H_0}\right)^3 \tag{11}$$

If (c/H_0) is the present electromagnetic interaction range, then present electromagnetic potential can be expressed as

$$\left(E_e\right)_0 \cong \frac{e^2}{4\pi\epsilon_0\left(c/H_0\right)} \tag{12}$$

Now inverse of the present fine structure ratio can be expressed as

$$\left(\frac{1}{\alpha}\right)_0 \cong \ln\sqrt{\frac{\left(E_T\right)_0}{2\left(E_e\right)_0}} \tag{13}$$

Here, in RHS, denominator '2' may be a representation of total thermal energy in half of the cosmic sphere or thermal energy of any one pole of the cosmic sphere. This is a simple and direct application of the proposed assumptions. Thus at any cosmic time,

$$\left(\frac{1}{\alpha}\right)_t \cong \ln\sqrt{\frac{\left(E_T\right)_t}{2\left(E_e\right)_t}} \tag{14}$$

If $M_t \to \sqrt{\frac{e^2}{4\pi\epsilon_0 G}}$ and $\left(aT_t^4\right) \to \frac{3H_t^2 c^2}{8\pi G}$, $\left(\frac{1}{\alpha}\right)_t \to 0.$

This may be considered as the cosmological definition for the fine structure ratio. Semi empirically to a good approximation, it is noticed that,

$$\frac{1}{\alpha_t} \cong \ln\left(\frac{x}{1+\ln(x)}\right) \tag{15}$$

Here $x \cong \sqrt{\frac{4\pi\epsilon_0 G M_t^2}{e^2}}$. If $M_t \to \sqrt{\frac{e^2}{4\pi\epsilon_0 G}}$, $\left(\frac{1}{\alpha}\right)_t \to 0.$

With this relation and with reference to the current magnitude of the fine structure ratio, obtained value of the present Hubble's constant is 71.75 km/sec/Mpc. Now the reduced Planck's constant can be expressed as

$$\hbar_t \cong \frac{1}{\alpha_t}\cdot\frac{e^2}{4\pi\varepsilon_0 c} \tag{16}$$

From this relation it is possible to say that, cosmological rate of change in fine structure ratio, $(d\alpha/dt)$ or $(d\hbar/dt)$ may be considered as an index of the future cosmic expansion or acceleration. More recently, theoretical interest in varying constants (not just α) has been motivated by string theory [24] and other such proposals for going beyond the Standard Model of particle physics. In October 2011 Webb *et al.* reported a variation in α dependent on both redshift and spatial direction [25]. Till today from ground based laboratory experiments no variation was noticed in the magnitude of the fine structure ratio. Future experiments and observations may reveal the real picture.

Including the CMB radiation energy density and the observed matter-energy density, in this connection, authors observed so many interesting relations in unification outline. The proposed relations (1) to (16) are best examples for this. In the following sections, authors proposed important observations and concepts related to Mach's principle, Hubble volume and the fundamental cosmological interactions.

The cosmic 'critical density' and its dimensional analysis

Recent findings from the University of Michigan suggest that the shape of the Big Bang might be more complicated than previously thought, and that the early universe spun on an axis. A left-handed and right-handed imprint on the sky as reportedly revealed by galaxy rotation would imply the universe was rotating from the very beginning and retained an overwhelmingly strong angular momentum [26]. Galaxies spin, stars spin, and planets spin. So, why not the whole universe? The consequences of a spinning universe seems to be profound [27-37], natural and 'cosmic collapse' can be prevented. Thus 'cosmic (light speed) rotation' can be considered as an alternative to the famous 'repulsive gravity' concept.

With a simple derivation it is possible to show that, Hubble's constant $\left(H_t\right)$ represents cosmological angular velocity. Assume that, a planet of mass (M) and size (R) rotates with angular velocity $\left(\omega_e\right)$ and linear velocity $\left(v_e\right)$ in such a way that, free or loosely bound particle of mass (m) lying on its equator gains a kinetic energy equal to potential energy as,

$$\frac{1}{2}mv_e^2 = \frac{GMm}{R} \tag{17}$$

$$R\omega_e = v_e = \sqrt{\frac{2GM}{R}} \text{ and } \omega_e = \frac{v_e}{R} = \sqrt{\frac{2GM}{R^3}} \tag{18}$$

i.e Linear velocity of planet's rotation is equal to free particle's escape velocity. Without any external power or energy, test particle gains escape velocity by virtue of planet's rotation. Using this idea, 'Black hole radiation' and 'origin of cosmic rays' can be understood. Note that if Earth completes one rotation in one hour then free particles lying on the equator will get escape velocity. Now writing, $M = \frac{4\pi}{3}R^3\rho_e$,

$$\omega_e = \frac{v_e}{R} = \sqrt{\frac{8\pi G\rho_e}{3}} \text{ Or } \omega_e^2 = \frac{8\pi G\rho_e}{3} \tag{19}$$

$$\text{Density, } \rho_\mathrm{e} = \frac{3\omega_\mathrm{e}^2}{8\pi \mathrm{G}} \tag{20}$$

In real time, this obtained density may or may not be equal to the actual density. But the ratio, $\frac{8\pi G\rho_{real}}{3\omega_{real}^2}$ may have some physical meaning. The most important point to be noted here, is that, as far as dimensions and units are considered, from equation (20), it is very clear that, proportionality constant being $\frac{3}{8\pi G}$,

$$\text{density} \propto (\text{angular velocity})^2 \tag{21}$$

Equation (20) is similar to "flat model concept" of cosmic "critical density"

$$\rho_c = \frac{3H_t^2}{8\pi G} \tag{22}$$

Comparing equations (20) and (22) dimensionally and conceptually, i.e.

$$\rho_e = \frac{3\omega_e^2}{8\pi G} \text{ with } \rho_\mathrm{c} = \frac{3H_\mathrm{t}^2}{8\pi \mathrm{G}} \tag{23}$$

$$H_t^2 \to \omega_\mathrm{e}^2 \text{ and } H_t \to \omega_e \tag{24}$$

It is very clear that, dimensions of 'Hubble's constant' must be 'radian/second'. In any physical system under study, for any one 'simple physical parameter' there will not be two different units and there will not be two different physical meanings. This is a simple clue and brings "cosmic rotation" into picture. This is possible in a closed universe only. Cosmic models that depends on this "critical density" may consider 'angular velocity of the universe' in the place of 'Hubble's constant'. In the sense, 'cosmic rotation' can be included in the existing models of cosmology. Then the term 'critical density' appears to be the 'volume density' of the closed and expanding universe.

About the Avogadro number

The subject of unification is very interesting and very complicated [38-41]. 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 [20]. 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. Even if Avogadro number is a man-made number, authors humble opinion is - first let us find the various applications of the Avogadro number in unification. At any one nice relation, its meaning can be understood. The ratio of Planck mass and electron rest mass is close to Avogadro number/ 8π. This is a very interesting and surprising result.

Possible assumptions in unified cosmic physics

The possible assumptions in unified cosmic physics can be expressed in the following way [42-70]:

A) With reference to the elementary charge, a new mass unit can be constructed in the following way. It can be called as the 'Coulomb mass'.

$$M_C \cong \sqrt{\frac{e^2}{4\pi\epsilon_0 G}} \cong 1.859210775\times10^{-9} \text{ Kg} \tag{25}$$

$$\cong 1.042941\times10^{18} \text{ GeV/c}^2$$

B) Hubble length (c/H_t) can be considered as the gravitational or electromagnetic interaction range.
C) Being a 'primordial evolving black hole' [47-49],[53-56] and angular velocity being H_t, universe is always rotating with light speed.
D) In atomic and nuclear physics, gravitational constant exhibits integral behaviour.
E) Thre exits a heavy charged elementary particle and its mass is close to Avogadro number times the ret mass of electron. Thus $M_X \cong N.m_e \cong 5.4857991 \times 10^{-7}$ kg.
F) For any observable charged particle, there exist 2 kinds of masses and their mass ratio is $\gamma \cong 295.0606339$ where γ^2 is the gravitational and electromagnetic force ratio of M_X. First kind of mass seems to be the 'gravitational or observed' mass and the second kind of mass plays a crucial role in deciding the particle size.
G) For any elementary particle of charge e, characteristic mass (m/γ) and characteristic radius R, it can be assumed as

$$\frac{e^2}{4\pi\epsilon_0 R} \cong \frac{1}{2}\left(\frac{m}{\gamma}\right)c^2 \tag{26}$$

This idea can be applied to proton as well as electron.

H) In modified quark SUSY [59-61], if m_f is the mass of quark fermion and m_b is the mass of quark boson, then

$$\frac{m_f}{m_b} \cong \Psi \cong 2.2627062 \tag{27}$$

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

$$\Psi^2 \ln\left(1+\frac{1}{(\gamma\alpha_0)^2}\right) \cong 1 \tag{28}$$

At low and high energies, with this idea SUSY can be observed in the strong interaction as well as in the electroweak interaction.

Key concepts and relations

At any given cosmic time t,

1) The Schwarzschild radius of universe is

$$\frac{2GM_t}{c^2} \cong \frac{c}{H_t} \tag{29}$$

where M_t is the cosmic mass at that time. The cosmic mass can be expressed as

$$M_t \cong \frac{c^3}{2GH_t}. \tag{30}$$

It can be called as the 'Hubble mass'. Thus the cosmic volume density takes the following well known 'critical density' form,

$$(\rho_v)_t \cong \frac{c^3}{2GH_t} \div \frac{4\pi}{3}\left(\frac{c}{H_t}\right)^3 \cong \frac{3H_t^2}{8\pi G}. \tag{31}$$

It can be called as the cosmic Hubble density.

2) $\frac{d(\alpha)}{dt}$ or $\frac{d(h)}{dt}$ or $\frac{d(\hbar)}{dt}$ is a measure of cosmic rate of expansion. It is possible to show that, potential energy of electron in hydrogen atom is directly proportional to $\hbar^2$. Bohr's second postulate which suggests that potential energy of electron in hydrogen atom is inversely proportional to $\hbar^2$ seems to be a coincidence [71,72].
3) Past light quanta emitted from aged galaxy will have less energy and show a red shift with reference to the receiving galaxy. During journey light quanta will not lose energy and there will be no change in light wavelength.
4) The basic definition of redshift (z) seems to be $z \cong \frac{\lambda_G - \lambda_0}{\lambda_G}$ but not $z \cong \frac{\lambda_G - \lambda_0}{\lambda_0}$. Here λ_G is the wave length of light received from observed galaxy and λ_0 is the wave length of light in laboratory. Note that, based on the increasing value of the Planck's constant, red shift (z) will be directly proportional to the age difference of our galaxy and the old galaxy (Δt). Thus $z \propto \Delta t$ and $z \cong H_t \Delta t$. Here H_t is the proportionality constant. In this way H_t can be incorporated directly. Our galaxy and observed galaxy age difference is, $\Delta t \cong \frac{z}{H_t}$. If $c\Delta t$ is a measure of galaxy distance, then

$$c\Delta t \cong z \cdot \frac{c}{H_t}. \tag{32}$$

In this way, the basic and original definition of 'galaxy receding' and 'accelerating universe' concepts can be eliminated and a 'decelerating or expanded universe' concept can be continued without any difficulty.

5) 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 it is noticed that,

$$\ln\left(\frac{M_0}{M_X}+\frac{M_0}{M_X}\right) \cong \ln\left(\frac{2M_0}{M_X}\right) \cong \frac{1}{\alpha} \cong 137.015 \tag{33}$$

where H_0 is close to 71 km/sec/Mpc. With this idea from relation (7) relation (6) can be obtained.

With reference to the present fine structure ratio and with 'molar electron mass', obtained H_0 is 69.53 km/sec/Mpc . This can be compared with the recently recommended value [16] $H_0 \cong 69.32 \pm 0.80$ km/sec/Mpc. This is one remarkable coincidence and seems to play a vital role in future unified physics.

6) If $\sqrt{\frac{e^2}{4\pi\epsilon_0 G}} \cong M_C$ is a representation of the characteristic mass of the early universe, characteristic early size of universe can be expressed as

$$R_C \cong \frac{2GM_C}{c^2} \cong 2.76\times10^{-36} \text{ m} \quad (34)$$

If H_0 is close to 71 km/sec/Mpc, present cosmic size can be expressed as

$$R_0 \cong \frac{c}{H_0} \cong \frac{2GM_0}{c^2} \cong 1.301\times10^{26} \text{ m} \quad (35)$$

Surprisingly it is noticed that,

$$\left(R_0 R_C^2\right)^{\frac{1}{3}} \cong 9.974\times10^{-16} \text{ m} \cong 1 \text{ fm} \quad (36)$$

This length can be compared with the characteristic strong interaction range. It is very close to the proton 'rms' radius. Thus in a heuristic way, the observed strong interaction range (R_s) can be expressed as

$$\left(R_s\right)_0 \approx \left(\frac{M_0}{M_C}\right)^{\frac{1}{3}} \cdot \frac{2GM_C}{c^2} \cong \left(\frac{V_0}{V_C}\right)^{\frac{1}{3}} \cdot \frac{2GM_C}{c^2} \quad (37)$$

where $V_C \cong \frac{4\pi}{3}R_C^3$ and $V_0 \cong \frac{4\pi}{3}R_0^3$. This is a very simple relation that connects the assumed 'Black hole universe' and the experimental 'atomic nucleus'.

7) Considering the above concepts it can be suggested that, there exists a strong connection in between modern cosmology and the nucleus. It is noticed that,

$$R_s \cong \frac{2G\sqrt{M_0\left(m_p/\gamma\right)}}{c^2} \cong 1.05\times10^{-15} \text{ m} \quad (38)$$

Here H_0 is close to 70 km/sec/Mpc and $M_0 \cong 8.773\times10^{52}$ kg. Here R_s represents the Schwarzschild radius of $\sqrt{M_0\left(m_p/\gamma\right)}$ and the very peculiar and careful observation is

$$R_s \cong \sqrt{\left(\frac{2GM_0}{c^2}\right)\left(\frac{2G\left(m_p/\gamma\right)}{c^2}\right)} \quad (39)$$

The cosmic physical parameters

Cosmic Matter Density

Approximate relation between cosmic volume density $\left(\rho_v\right)_t$ and matter density $\left(\rho_m\right)_t$ can be expressed as

$$\left(\rho_m\right)_t \cong \left[1+\ln\sqrt{\frac{4\pi\epsilon_0 GM_t^2}{e^2}}\right]^{-1}\left(\frac{3H_t^2}{8\pi G}\right) \quad (40)$$

If $M_t \to \sqrt{\frac{e^2}{4\pi\epsilon_0 G}}$, $\left(\rho_m\right)_t \to \frac{3H_t^2}{8\pi G}$. Instead of the 'Planck mass', initial conditions can be addressed with $M_C \cong \sqrt{\frac{e^2}{4\pi\epsilon_0 G}}$. Note that, at present obtained matter density can be compared with the elliptical and spiral galaxy matter density. Based on the average mass-to-light ratio for any galaxy [73]

$$\left(\rho_m\right)_0 \cong 1.5\times10^{-32}\eta h_0 \text{ gram/cm}^3 \quad (41)$$

where for any galaxy, $\langle M/L\rangle_{Galaxy} = \eta\langle M/L\rangle_{\text{Sun}}$ and the number: $h_0 \cong \frac{H_0}{100 \text{ Km/sec/Mpc}} \cong \frac{71.0}{100} \cong 0.71$. Note that elliptical galaxies probably comprise about 60% of the galaxies in the universe and spiral galaxies are thought to make up about 20% of the galaxies in the universe. Almost 80% of the galaxies are in the form of elliptical and spiral galaxies. For spiral galaxies, $\eta h_0^{-1} \cong 9 \pm 1$ and for elliptical galaxies, $\eta h_0^{-1} \cong 10 \pm 2$. For our galaxy inner part, $\eta h_0^{-1} \cong 6 \pm 2$. Thus the average ηh_0^{-1} is very close to 8 to 9 and its corresponding matter density is (6.05 to 6.8) $\times 10^{-32}$ gram/cm^3.

Cosmic Thermal Energy Density

At any given cosmic time, ratio of cosmic volume energy density and cosmic thermal energy can be expressed as

$$\left(\frac{\rho_v c^2}{aT^4}\right)_t \cong \left[1+\ln\sqrt{\frac{4\pi\epsilon_0 GM_t^2}{e^2}}\right]^2 \quad (42)$$

If so, at any given cosmic time, thermal energy density can be expressed as

$$aT_t^4 \cong \left[1+\ln\sqrt{\frac{4\pi\epsilon_0 GM_t^2}{e^2}}\right]^{-2}\left(\frac{3H_t^2c^2}{8\pi G}\right) \quad (43)$$

If $M_t \to \sqrt{\frac{e^2}{4\pi\epsilon_0 G}}$, $aT_t^4 \to \frac{3H_t^2c^2}{8\pi G}$. If H_0 is close to 71.1 km/sec/Mpc, obtained CMBR temperature [18] is 2.725 ^{0}K. At any given cosmic time, without considering the radiation constants and CMBR temperature, equivalent thermal energy density can be obtained in this way. This is a very important point to be noted here. If (a) is the radiation constant and (b) is the Wein's displacement constant, it is noticed that a factor connected with (a,b) is 1.3333991714 and is close to (4/3). Thus

$$a \cong \frac{8\pi^5}{15}\frac{k_B^4}{h^3c^3} \cong \left(\frac{8\pi^5}{15\times(4.96511423)^3}\right)\cdot\frac{k_B}{b^3}$$

$$\cong 1.3333991714\cdot\frac{k_B}{b^3} \cong \frac{4}{3}\cdot\frac{k_B}{b^3} \quad (44)$$

Thus in a classical approach, independent of the Planck's constant, radiation constant can be expressed as above. This is a very sensitive point to be discussed [74,75]. Wien's law is based on classical approach. With reference to Wein's displacement law, it can be understood that, for any black body, most strongly emitted thermal wave length is inversely proportional to its absolute temperature. Even with reference to quantum mechanics also, 'Wein's constant' is a cosmological constant. With reference to the current magnitude of the Planck's constant, accurate value of the Wein's constant can be estimated and that obtained magnitude can be considered as a constant throughout the cosmic time. Now it can be suggested that, at any given cosmic time, matter energy density can be considered as the geometric mean of thermal-energy density and volume-energy density.

$$\left(\rho_m c^2\right)_t \cong \sqrt{\left(aT_t^4\right)\left(\frac{3H_t^2c^2}{8\pi G}\right)} \cong \sqrt{\left(aT^4\right)_t\left(\rho_v c^2\right)_t} \quad (45)$$

Direct estimation of wavelength of the CMB radiation

Authors noticed another two approximate methods for estimating the CMB radiation. Geometric mean of the 2 methods is fitting with the observational data accurately[16].

Method-1: With reference to the Wein's displacement law wave length of the most strongly emitted CMB radiation can be expressed as

$$\left(\lambda_m\right)_t \cong \left(\frac{\rho_v}{\rho_m}\right)_t \frac{G\sqrt{M_tM_C}}{c^2}$$

$$\cong \left[1+\ln\left(\frac{M_t}{M_C}\right)\right]\frac{G\sqrt{M_tM_C}}{c^2} \quad (46)$$

Note that this expression is free from the 'radiation constants'. If H_0 is close to 70 km/sec/Mpc, obtained (most strongly emitted) wavelength of the CMB radiation is 1.37 mm.

Method-2: This method is based on the pair annihilation of $(M_C)^{\pm}$. At any time, thermal energy can be expressed as

$$k_BT_t \cong \sqrt{\frac{M_C}{M_t}}\cdot\left[(M_C)^+ + (M_C)^-\right]c^2 \quad (47)$$

$$\cong \sqrt{\frac{M_C}{M_t}}\cdot 2M_Cc^2$$

Based on Wein's displacement law,

$$\left(\lambda_m\right)_t \cong \frac{b}{T_t} \cong \sqrt{\frac{M_t}{M_C}}\cdot\frac{bk_B}{2M_Cc^2} \quad (48)$$

If H_0 is close to 70 km/sec/Mpc, obtained (most strongly emitted) wavelength of the CMB radiation is 0.822 mm.

Method-3: Considering the geometric mean wave length of wave lengths obtained from method-1 and method-2, wave length of the most strongly emitted CMB radiation can be expressed as

$$\left(\lambda_m^2\right)_t \cong \left[1+\ln\left(\frac{M_t}{M_C}\right)\right]\cdot\left(\frac{M_t}{M_e}\right)\cdot\left(\frac{bk_BG}{2c^4}\right) \quad (49)$$

$$\left(\lambda_m\right)_t \cong \sqrt{\left[1+\ln\left(\frac{M_t}{M_C}\right)\right]\cdot\left(\frac{M_t}{M_C}\right)\cdot\left(\frac{bk_BG}{2c^4}\right)} \quad (50)$$

If H_0 is close to 70 km/sec/Mpc, obtained (most strongly emitted) wavelength of the CMB radiation is 1.064 mm. In this way, in a semi empirical approach, the observed CMB radiation temperature can be understood. Clearly speaking,

$$\left(\lambda_m\right)_t \propto \sqrt{\left(\frac{\rho_v}{\rho_m}\right)_t} \propto \sqrt{1+\ln\left(\frac{M_t}{M_C}\right)} \quad (51)$$

$$\left(\lambda_m\right)_t \propto \sqrt{\frac{M_t}{M_C}} \quad (52)$$

and $\sqrt{\frac{bk_BG}{2c^4}} \cong 1.2856\times10^{-35}$ m seems to be a 'classical' constant and can be considered as the characteristic 'classical' thermal wave length. The most important point is that, as the black hole universe is expanding, its expansion rate can be checked with $\frac{d}{dt}(\lambda_m)$. Present observations indicates that, CMB radiation is smooth and uniform. Thus it can be suggested that, at present there is no detectable cosmic expansion or cosmic acceleration.

Cosmological Nuclear characteristic radii

The characteristic nuclear charge radius

If $H_0 \cong 71$ Km/sec/Mpc, R_s is the characteristic radius of nucleus, it is noticed that,

$$R_s \cong \left(\frac{m_p}{M_X}\right)^2\frac{c}{H_0} \cong 1.2114\times10^{-15}\text{ m} \quad (53)$$

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

Scattering distance between electron and the nucleus

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

$$R_s \cong \left(\frac{\hbar_0 c}{GM_X m_e}\right)^2 \cdot \frac{2Gm_e}{c^2} \cong 1.21565 \times 10^{-15}\text{ m} \quad (54)$$

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'. Combining these two relations (53 & 54), relation (6) can be obtained.

Semi empirical applications of M_X, γ and α_0 in atomic, nuclear and particle physics

Application-1: Relation between $\hbar_0$ and γ

If $\hbar_0$ is the quantum of the gravitational angular momentum, then its characteristic quantum can be expressed as $\left(\frac{\hbar_0}{\gamma}\right)$. Thus the ratio,

$$\left(\frac{\hbar_0}{\gamma}\right) \div \left(\frac{e^2}{4\pi\epsilon_0 c}\right) \cong (\gamma\alpha_0)^{-1} \quad (55)$$
$$\cong 0.464433353 \cong \sin\theta_W$$

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

Application-2: Radii of proton and electron

Radius of any charged elementary particle of rest mass (m) can be estimated as

$$R \cong 2\gamma \frac{e^2}{4\pi\epsilon_0 mc^2} \cong \left(\frac{M_X}{m}\right) \cdot \frac{2GM_C}{c^2} \quad (56)$$

For the proposed new particle of mass M_X, its radius can be expressed as

$$R_X \cong 2\gamma \frac{e^2}{4\pi\epsilon_0 M_X c^2} \cong \frac{2GM_C}{c^2} \quad (57)$$

Electron's characteristic radius is

$$R_e \cong 2\gamma \frac{e^2}{4\pi\epsilon_0 m_e c^2} \cong \frac{M_X}{m_e} \cdot \frac{2GM_C}{c^2}$$
$$\cong 1.663 \times 10^{-12}\text{ m} \quad (58)$$

Similarly proton's characteristic radius is

$$R_p \cong 2\gamma \frac{e^2}{4\pi\epsilon_0 m_p c^2} \cong \frac{M_X}{m_p} \cdot \frac{2GM_C}{c^2}$$
$$\cong 0.906 \times 10^{-15}\text{ m} \quad (59)$$

This obtained magnitude can be compared with the 'rms charge radius' of the proton.

Application-3: Magnetic moments of electron, proton, neutron and planet Earth

From above application, magnetic moment [63,76] of any elementary particle of mass (m) and charge (e) can be expressed as

$$\mu \cong \frac{x}{\alpha_0} \cdot ec \cdot \frac{e^2}{4\pi\epsilon_0 mc^2} \quad (60)$$

where x is factor to be determined. For electron, value of is $x \cong \frac{1}{2}$. Thus for electron its magnetic moment can be expressed as

$$\mu_e \cong \frac{1}{2\alpha_0} \cdot ec \cdot \frac{e^2}{4\pi\epsilon_0 m_e c^2} \cong \frac{e\hbar_0}{2m_e} \quad (61)$$

Magnetic moment of proton [20] can be expressed as

$$\mu_p \cong \frac{\sqrt{2}}{\alpha_0} \cdot ec \cdot \frac{e^2}{4\pi\epsilon_0 m_p c^2} \cong 1.4286 \times 10^{-26}\text{ J/tesla} \quad (62)$$

The interesting point to be noted here is that, in case of proton $x \cong \sqrt{2}$ and in case of neutron $x \cong 1$. Magnitude of magnetic moment of neutron [20] can be expressed as

$$\mu_n \cong \frac{1}{\alpha_0} \cdot ec \cdot \frac{e^2}{4\pi\epsilon_0 m_n c^2} \cong 1.0088 \times 10^{-26}\text{ J/tesla} \quad (63)$$

With reference to the proposed idea of discrete behavior of the gravitational constant, magnetic moments of neutron and proton can be expressed as

$$\mu \cong \frac{1}{\gamma\alpha_0} \cdot \left(\frac{M_X}{m_p}\right) \cdot e^2 \cdot \sqrt{\frac{\mu_0 (n.G)}{4\pi}}$$
$$\cong \frac{\sqrt{n}}{\gamma\alpha_0} \cdot \left(\frac{M_X}{m_p}\right) \cdot e^2 \cdot \sqrt{\frac{\mu_0 G}{4\pi}} \quad (64)$$

where $n = 1, 2, ..$ For electron,

$$\mu_e \cong \frac{1}{2\gamma\alpha_0} \cdot \left(\frac{M_X}{m_e}\right) \cdot e^2 \cdot \sqrt{\frac{\mu_0 G}{4\pi}} \quad (65)$$

Table-1: To fit the magnetic moments of celestial bodies.

Planet /Star	Mass (kg)	Obtained μ (J/tesla)	Measured μ (J/tesla)
Earth	5.974E24	7.739E22	7.84E22
Jupiter	1.899E27	4.385E26	1.55E27
Saturn	5.685E26	7.184E25	4.6E25
Uranus	8.685E25	4.29E24	3.9E24
Neptune	1.024E26	5.495E24	2.2E24
Mercury	3.3E23	1.0E21	4.0E19
Ganymede	1.482E23	3.024E20	1.32E20
Sun	1.991E30	4.89E29	3.5E29

Note that, heavenly body magnetic moments can be fitted with the semi empirical expression.

$$\mu_h \cong \frac{1}{2\gamma\alpha_0}\cdot\left(\frac{M_h}{M_X}\right)^{3/2}\cdot\mu_R \tag{66}$$

Here μ_h is the magnetic moment of the heavenly body, μ_R is the reference magnetic moment and M_h is the mass of heavenly body. In case of planets, $\mu_R \cong \mu_e$. For stars, $\mu_R \cong \sqrt{\mu_e\mu_n}$ and for compact objects, $\mu_R \cong \mu_n$. For planets, if $\mu_R \cong \mu_e$,

$$\mu_h \cong 5.3\times10^{-15}\times M_h^{3/2} \text{ J/tesla} \tag{67}$$

Please see table-1 for the heavenly bodies magnetic moments [77.78]. In case of Sun, $\mu_R \cong \sqrt{\mu_e\mu_n}$.

Application-4: Potential energy of electron in Hydrogen atom

Let E_p be the potential energy of electron in the Hydrogen atom. It is noticed that,

$$\left(\frac{e^2}{4\pi\epsilon_0 GM_X^2}\right)\sqrt{\frac{\sqrt{m_p m_e^3}}{2}}.c^2 \cong \alpha_0^2 m_e c^2 \tag{68}$$

This is an observation. Here, LHS = 27.356 eV and RHS = 27.21138 eV. Error is 0.5315%. With reference to the error bars [20] in the magnitudes of (N) and (G), this relation can be given a chance. Now potential energy of electron can be expressed as

$$E_p \cong -\left[\left(\frac{e^2}{4\pi\epsilon_0 GM_X^2}\right)\sqrt{\frac{\sqrt{m_p m_e^3}}{2}}.c^2\right]^2 \div\alpha_0^2 m_e c^2 \tag{69}$$

On simplification, it takes the following simple form.

$$E_p \cong -\left(\frac{\hbar_0 c}{GM_X^2}\right)^2\cdot\frac{\sqrt{m_p m_e}\cdot c^2}{2} \cong -\alpha_0^2 m_e c^2 \tag{70}$$

Here $\left(\frac{\hbar_0 c}{GM_X^2}\right)^2\cdot\frac{\sqrt{m_p m_e}\cdot c^2}{2} \cong 27.12493$ eV and

$\alpha_0^2 m_e c^2 \cong 27.21138$ eV and error is 0.3177%. From above applications, it is also noticed that,

$$E_p \cong -\frac{e^2}{4\pi\epsilon_0 a_0} \cong -\left(\frac{\hbar_0 c}{GM_X^2}\right)\frac{(\hbar_0/\gamma)c}{\sqrt{R_e R_p}} \tag{71}$$

$$\cong -27.12493044 \text{ eV}$$

where a_0 is the Bohr radius [32,33]. From above relations,

$$\left(\frac{\hbar_0 c}{GM_X^2}\right)\frac{(\hbar_0/\gamma)c}{\sqrt{R_e R_p}} \cong \left(\frac{\hbar_0 c}{GM_X^2}\right)\left(\frac{1}{\gamma^2\alpha_0}\right)\frac{\sqrt{m_p m_e}c^2}{2} \tag{72}$$

and $\left(\frac{1}{\gamma^2\alpha_0}\right) \cong \left(\frac{\hbar_0 c}{GM_X^2}\right)$. Thus

$$E_p \cong -\left(\frac{\hbar_0 c}{GM_X^2}\right)^2\frac{\sqrt{m_p m_e}c^2}{2} \tag{73}$$

Here error is 0.3178%. Without considering the integral nature of angular momentum [71,72], here by considering the assumed integral nature of the gravitational constant, discrete nature of revolving electron's potential energy can be expressed as,

$$E_p \cong \left(\frac{\hbar_0 c}{(n.G)M_X^2}\right)^2\frac{\sqrt{m_p m_e}c^2}{2} \tag{74}$$

where n =1,2,3,..Now the fundamental question to be answered is- How $(\hbar_0)$ varies with time? Answer can be obtained from analyzing the relations (6), (7), (8) and (16). It has to be confirmed from past data (galaxy age and redshift) analysis or future observations (on galaxy age and redshift) or with a suitable selected model. Thus the Bohr radius can be expressed as

$$a_0 \cong \left(\frac{GM_X^2}{\hbar_0 c}\right)^2\frac{2e^2}{4\pi\epsilon_0\sqrt{m_p m_e}c^2} \tag{75}$$

Discrete Bohr radii can be expressed as

$$a_n \cong \left(\frac{(n.G)M_X^2}{\hbar_0 c}\right)^2\frac{2e^2}{4\pi\epsilon_0\sqrt{m_p m_e}c^2} \cong n^2\cdot a_0 \tag{76}$$

where a_n is the radius of n^{th} orbit and $n = 1,2,3,..$ Thus in Hydrogen atom, potential energy of electron in n^{th} orbit can be expressed as

$$E_p \cong -\frac{e^2}{4\pi\epsilon_0 a_n} \cong -\left(\frac{\hbar_0 c}{GM_X^2}\right)^2\frac{\sqrt{m_p m_e}c^2}{2n^2} \tag{77}$$

Application-5: To fit the nuclear binding energy constants

The semi-empirical mass formula (SEMF) is used to approximate the mass and various other properties of an atomic nucleus [79- 82]. As the name suggests, it is based partly on theory and partly on empirical measurements. 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

$$BE \cong Aa_v - A^{\frac{2}{3}}a_s - \frac{Z(Z-1)}{A^{\frac{1}{3}}}a_c - \frac{(A-2Z)^2}{A}a_a \pm \frac{1}{\sqrt{A}}a_p \tag{78}$$

It is noticed that,

$$a_v + a_s \cong a_a + a_p \cong \frac{3}{2}a_a \cong \frac{m_p c^2}{1+\sqrt{k}} \tag{79}$$

$$\cong 35.8045 \text{ MeV}$$

where $k \cong \frac{GM_X^2}{\hbar_0 c} \cong \gamma^2 \alpha_0$.

Asymmetric energy constant be

$$a_a \cong \frac{2}{3} \cdot \left(\frac{m_p c^2}{1+\sqrt{k}} \right) \cong 23.870 \text{ MeV} \quad (80)$$

Pairing energy constant be

$$a_p \cong \frac{a_a}{2} \cong \frac{1}{3} \cdot \left(\frac{m_p c^2}{1+\sqrt{k}} \right) \cong 11.935 \text{ MeV} \quad (81)$$

The maximum nuclear binding energy per nucleon be

$$B_m \cong \frac{1}{4} \cdot \left(\frac{m_p c^2}{1+\sqrt{k}} \right) \cong 8.9511 \text{ MeV} \quad (82)$$

Coulombic energy constant be

$$a_c \cong \sqrt{\alpha_0} . B_m \cong 0.7647 \text{ MeV} \quad (83)$$

Surface energy constant be

$$a_s \cong 2B_m \left(1 + \sqrt{\frac{a_c}{a_a}} \right) \cong 19.504 \text{ MeV} \quad (84)$$

Volume energy constant be

$$a_v \cong 2B_m \left(1 - \sqrt{\frac{a_c}{a_a}} \right) \cong 16.30 \text{ MeV} \quad (85)$$

In table-2 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 [82]. Column-3 represents the calculated binding energy and column-4 represents the measured binding energy.

Table 2. SEMF binding energy with the proposed energy coefficients

Z	A	$(BE)_{cal}$ in MeV	$(BE)_{meas}$ in MeV
26	56	492.17	492.254
28	62	546.66	545.259
34	84	727.75	727.341
50	118	1007.76	1004.950
60	142	1184.50	1185.145
79	197	1556.66	1559.40
82	208	1627.11	1636.44
92	238	1805.60	1801.693

Proton-nucleon stability relation can be expressed as

$$\frac{A_s}{2Z} \cong 1 + 2Z \left(\frac{a_c}{a_s} \right)^2 \quad (86)$$

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 [79]. Stable super heavy elements can also be predicted with this relation.

$$A_s \cong 2Z \left[1 + 2Z \left(\frac{a_c}{a_s} \right)^2 \right] \cong 2Z + Z^2 * 0.00615 \quad (87)$$

if $Z = 21$, $A_s \cong 44.71$; if $Z = 29$, $A_s \cong 63.17$;
if $Z = 47$, $A_s \cong 107.58$; if $Z = 53$, $A_s \cong 123.27$
if $Z = 60$, $A_s \cong 142.13$; if $Z = 79$, $A_s \cong 196.37$;
if $Z = 83$, $A_s \cong 208.36$; if $Z = 92$, $A_s \cong 236.04$;

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 up to $Z \approx 56$ can be fitted with the following relation.

$$A_s \cong 2Z \left[1 + 2Z \left(\left(\frac{a_c}{a_s} \right)^2 + \left(\frac{a_c}{4B_m} \right)^2 \right) \right] \quad (88)$$

$$\cong 2Z + Z^2 * 0.0080$$

From this relation for $Z = 56$, obtained upper $A_s \cong 137.1$. Note that, for $Z = 56$, actual stable $A_s \cong 137 \cong \frac{1}{\alpha_0}$ where α_0 is the fine structure ratio. This seems to be a nice and interesting coincidence. In between 0.00615 and 0.0080, for light and medium atoms up to $Z \approx 56$ or $A_s \approx 137$, mean stability can be fitted with the following relation.

$$A_s \cong 2Z + Z^2 * 0.00706 \quad (89)$$

Surprisingly it is noticed that, in this relation, $0.0071 \approx \alpha$. Thus up to $Z \cong 56$ or $A_s \approx 137$, mean stability can be expressed as

$$A_s \approx 2Z + \left(Z^2 \alpha_0 \right) \quad (90)$$

Application-6: To fit the muon and tau rest masses

Using γ charged muon and tau masses [19] were fitted in the following way.

$$m_l c^2 \approx \frac{2}{3} \left[a_c^3 + \left(n^2 \gamma \right)^n a_a^3 \right]^{\frac{1}{3}} \quad (91)$$

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.

Table 3: To fit the muon and tau rest masses

n	Obtained Lepton rest energy (MeV)	Experimental Lepton rest energy (MeV)
0	Defined	0.510998910(13)
1	105.951	105.6583668(38)
2	1777.384	1776.99(29)
3	(42262)	To be discovered

Accuracy can be improved with the following relation.

$$\text{If } E_W \cong \frac{m_e c^2}{\gamma} \cong 1.731843735\times10^{-3}\text{ MeV} \quad (92)$$

$$m_l c^2 \cong \left[\gamma^3 + \left(n^2\gamma\right)^n \sqrt{N}\right]^{\frac{1}{3}} E_W \quad (93)$$

where $n = 0,1,2$. Please see table-3.

Application-7: Charged pion and its ground state SUSY boson

Based on the proposed SUSY, it is also noticed that

$$\left(m_\pi c^2\right)^{\pm} \cong \frac{1}{\Psi}\cdot\sqrt{m_\mu m_p} \cong 139.34\text{ MeV} \quad (94)$$

With this coincidence it is very natural to apply this idea to electron and proton system. When muon is the excited form of electron and if pion is the SUSY boson of muon, then it is natural to think that there exists a SUSY boson of electron-proton system. It can be called as 'EPION'. Its rest energy can be obtained as

$$\left(m_\varepsilon c^2\right)^{\pm} \cong \frac{1}{\Psi}\sqrt{m_p m_e}c^2 \cong 9.677\text{ MeV} \quad (95)$$

Considering the neutron rest mass and with this new 'epion', the neutral electro weak boson rest mass can be fitted as

$$m_Z \cong \frac{m_n^2}{m_\varepsilon} \cong 91224.86\text{ MeV} \quad (96)$$

Really this is a very surprising coincidence. In a simple form,

$$m_n \cong \sqrt{m_Z m_\varepsilon} \quad (97)$$

LHS of this relation represents a fermion where as RHS represents a boson. From SUSY point of view, this coincidence cannot be ignored. Life time of Z boson is close to

$$\sqrt{\frac{m_\varepsilon}{m_Z}}\cdot\frac{\hbar_0}{2m_\varepsilon c^2} \cong \frac{\hbar_0}{2\sqrt{m_\varepsilon m_Z}c^2} \cong 3.5\times10^{-25}\text{ sec} \quad (98)$$

From these coincidences it can be suggested that, 1) Pion is the excited state of Epion. 2) 'Epion' can be considered as the basic nuclear force carrier. If so Epion must have some role in basic nuclear structure and nuclear binding energy. With this boson, neutron mean life time $\left(\tau_n\right)$ can be fitted as

$$\tau_n \cong N\cdot\frac{m_n}{\Psi m_\varepsilon}\cdot\frac{\hbar}{2m_\varepsilon c^2} \cong 878.83\text{ sec} \quad (99)$$

Here $\tau_n \cong 880.1\pm1.1$ sec [19] and N is the Avogadro number. With this relation and by knowing the value of Ψ , Avogadro number can be estimated accurately. Thinking in this way, with reference to tau, a very excited charged boson of rest energy 570.73 MeV can be predicted.

Application-8: 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. Considering perturbative QCD calculations from threshold corrections, its recent obtained value [83] at is N^3LO $\alpha_s \cong 0.1139\pm0.0020.$ 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.

$$\left(\frac{1}{\alpha_s}\right)_0 \cong \ln\left(\gamma^2\sqrt{\alpha_0}\right) \cong 8.914239916 \quad (100)$$

This proposed value numerically can be compared with the current estimates of the α_s. Coulombic energy constant of the SEMF can be expressed as [62,81] $a_c \cong \left(\alpha\alpha_s\right)_0 m_p c^2$.

Application - 9: 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 flavors and each flavor holds certain mass. Charged flavor can be called as a quark. It is neither a fermion nor a boson. A fermion is a container for different charges, a charge is a container for different flavors and each flavor is a container for certain matter. If charged matter rests in a fermionic container 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 flavors are existing with 6 different masses then a single charge can have one or two or more flavors simultaneously. Since charge is a common property, mass of the multiple flavor charge seems to be the geometric mean of the mass of each flavor. If charge with flavor is called as a quark then charge with multi flavors can be called as a hybrid quark. Hybrid quark generates a multi flavor baryon. It is a property of 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. It can be suggested that,

1) There exist 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 baryons' and massive 'quark mesons'.
4) 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 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 $\left(Q_{E1}Q_{E2}\right)^{\frac{1}{2}} c^2$ or $\left(Q_{E1}Q_{E2}^2\right)^{\frac{1}{3}} c^2$ or $\left(Q_{E1}Q_{E2}Q_{E3}\right)^{\frac{1}{3}} c^2$ 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 $\left(\frac{2U_F D_F}{U_F + D_F}\right)c^2 \cong 940.02$ MeV and nucleon rest energy difference is close to $\left(m_n - m_p\right)c^2 \cong \left(\frac{1}{\gamma\alpha_0}\right)^2\left(\frac{2U_f D_f}{U_f + D_f}\right)c^2 \cong 1.29623$ 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 $\left(Q_{M1} + Q_{M2}\right)c^2$ 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 $I = n(n+1), \left(mc^2\right)_I \cong \left[I\right]^{\frac{1}{4}} m_x c^2$ 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 $\left(mc^2\right)_I \cong \left[I\right]^{\frac{1}{12}} m_x c^2$ and $\left(mc^2\right)_{I/2} \cong \left[\frac{I}{2}\right]^{\frac{1}{12}} m_x c^2$.

In the previous papers [59,60] 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[84]. Up and down fermion masses can be given as

$$U_f c^2 \cong e^{\gamma\alpha_0} \times m_e c^2 \cong 4.4 \text{ MeV} \tag{101}$$

$$D_f c^2 \cong \gamma\alpha_0 \times U_f c^2 \cong 9.4755 \text{ MeV} \tag{102}$$

It is very interesting to note that

$$\frac{\text{Down fermion mass}}{\text{Up fermion mass}} \cong \frac{D_f}{U_f} \cong \gamma\alpha_0 \tag{103}$$

In this way $\gamma\alpha_0$ can be related with up and down quark mass ratio. Proposed USB geometric ratio is

$$g_U \cong \left[\gamma\alpha_0 \cdot \frac{\gamma\alpha_0 + 1}{\gamma\alpha_0 - 1}\right]^2 \cong 34.66294 \tag{105}$$

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

$$g_D \cong \left[2\gamma\alpha_0 \cdot \frac{\gamma\alpha_0 + 1}{\gamma\alpha_0 - 1}\right]^2 \cong 138.651754 \tag{105}$$

$$\frac{g_D}{g_U} \cong \frac{\text{DCT geometric ratio}}{\text{USB geometric ratio}} \cong 4. \tag{106}$$

$$\text{Quark boson mass } \left(Q_b\right) \cong \frac{\text{Quark fermion mass}\left(Q_f\right)}{\Psi} \tag{107}$$

Please see table-4 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 ± 0.058 GeV and 80.392 ± 0.039 GeV[19]. 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. It is noticed that

$$m_n c^2 \cong \left(\frac{1}{\alpha} + \frac{1}{\alpha_s}\right)_0 \sqrt{U_f D_f}\, c^2 - \frac{U_f}{D_f}\left(\frac{2U_f D_f}{U_f + D_f}\right)c^2 \cong 939.6 \text{ MeV} \tag{108}$$

$$m_p c^2 \cong \left(\frac{1}{\alpha}+\frac{1}{\alpha_s}\right)_0 \sqrt{U_f D_f}\ c^2 - \sqrt{\frac{U_f}{D_f}}\left(\frac{2U_f D_f}{U_f+D_f}\right)c^2$$
$$\cong 938.30 \text{ MeV} \quad (109)$$

where $\left(\frac{1}{\alpha}+\frac{1}{\alpha_s}\right)_0 \sqrt{U_f D_f}\ c^2 \cong 942.393$ MeV (110)

$$\frac{\sqrt{U_f D_f}\ c^2}{\left(m_n - m_p\right)c^2} \cong \ln\left(\frac{1}{\alpha}+\frac{1}{\alpha_s}\right)_0 \quad (111)$$

Table 4. Fitting of quark fermion and quark boson masses

Quark	$Q_f c^2$ in MeV	$Q_b c^2$ in 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

Application-10: Higgs 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. Mass of ΨM_{Hb} or M_{Hf} can be expressed with the following relations.

$$M_{Hf}c^2 \cong \frac{1}{2}\left(\frac{GM_X^2}{\hbar_0 c}\right)^2 \cdot m_e c^2 \quad (112)$$
$$\cong 103125.417 \text{ MeV}$$

$$M_{Hb}c^2 \cong \frac{M_{Hf}c^2}{\Psi} \cong \frac{1}{2}\cdot\left(\frac{GM_X^2}{\hbar_0 c}\right)^2 \cdot \frac{m_e c^2}{\Psi} \quad (113)$$
$$\cong 45576.1467 \text{ MeV}$$

Application-11: Rest energy of the neutral Z boson

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

$$m_Z c^2 \cong \left(M_{Hb}c^2\right)^{\pm} + \left(M_{Hb}c^2\right)^{\mp} \quad (114)$$

$\cong 2M_{Hb}c^2 \cong 91152.293$ MeV

$$m_Z c^2 \cong \left(\frac{GM_X^2}{\hbar_0 c}\right)^2 \cdot \frac{m_e c^2}{\Psi} \cong 91152.293 \text{ MeV} \quad (115)$$

This obtained value can be compared with the experimental [19] rest energy of Z boson = 91187.621 MeV. 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 [60]. In our previous paper [59] 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.

Application-12: 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

$$\left(M_{Hb}c^2\right)^{\pm} + \left(m_W c^2\right)^{\mp} \cong 126.0 \text{ GeV.} \quad (116)$$

This is an accurate and interesting fit.

Application-13: Quark baryon and quark meson masses with SUSY Higgs charged particle

In our earlier published paper it was assumed that [59], if Q_F is the quark baryon rest mass

$$Q_F c^2 \cong \left[M_{Gf}^2 \cdot Q_f\right]^{\frac{1}{3}} c^2 \quad (117)$$

If Q_E is the quark effective baryon rest mass,

$$Q_E c^2 \cong \left[M_{Gf}^2 \cdot Q_{ef}\right]^{\frac{1}{3}} c^2 \quad (118)$$

If Q_M is the quark meson rest mass,

$$Q_M c^2 \cong \left[M_{Gb}^2 \cdot Q_b\right]^{\frac{1}{3}} c^2 \quad (119)$$

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

$$Q_F c^2 \cong x\left[M_{Hf}^2 \cdot Q_f\right]^{\frac{1}{3}} c^2 \quad (120)$$

$$Q_E c^2 \cong x\left[M_{Hf}^2 \cdot Q_{ef}\right]^{\frac{1}{3}} c^2 \quad (121)$$

$$Q_M c^2 \cong x\left[M_{Hb}^2 \cdot Q_b\right]^{\frac{1}{3}} c^2 \quad (122)$$

where $x \cong \frac{1}{2\alpha_0(\gamma+1)} \cong 0.23143232$

Please see table-5 for the proposed 'quark baryon' rest energies and see table-6 for the 'quark meson' rest energies.

Discussion & Conclusions

Professor Recami says [41]: *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 as 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".*

Table 5. Fitting of quark baryon and quark effective baryon rest energies

Quark	$Q_f c^2$ in MeV	$Q_F c^2$ in MeV	$Q_{ef} c^2$ in MeV	$Q_E c^2$ in 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 6. Fitting of quark boson and quark meson rest energies

Quark	$Q_b c^2$ in MeV	$Q_M c^2$ in 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

In understanding the basic concepts of unification or TOE, role of dark energy and dark matter is insignificant. Based on the proposed relations and applications, Hubble volume or Hubble mass, can be considered as a key tool in unification as well as cosmology. If it is possible to identify the atomic cosmological physical variable, then by observing the rate of change in its magnitude (on the cosmological time scale), the cosmic acceleration can be verified and thus the cosmic geometry can be confirmed from atomic and nuclear physics! Without the advancement of nano-technology or femto-technology this may not be possible. Not only that, independent of the cosmic red shift and CMBR observations cosmic acceleration can be checked in this new direction.

With the proposed concepts and with the advancing science and technology, from the ground based laboratory experiments, from time to time the concept $d(\alpha)/dt$ or $d(\hbar)/dt$ can be put for experimental tests. There is no need to design a new experiment. Well established experiments are already available by which the fine structure ratio can be estimated. Moreover, conducting an experiment in this direction is also very simple. Only thing is that the same experiment has to be repeated for several times or continuously. This is also very simple. Thus in the near future one can expect the real picture. With reference to the present concepts of cosmic acceleration and with laboratory experiments one may not decide whether universe is accelerating or decelerating. Many experiments are under progress to detect and confirm the existence of dark matter and dark energy. Along with these experiments if one is willing to think in this new direction, from atomic and nuclear inputs it may be possible to verify the future cosmic acceleration.

Alternatively in a theoretical way, the proposed applications or semi empirical relations can be given a chance and the subject of elementary particle physics and cosmology can be studied in a unified manner. It is true that the proposed relations are speculative and peculiar also. By using the proposed relations and applying them in fundamental physics, in due course their role or existence can be verified. With these relations, Hubble constant can be estimated from atomic and nuclear physical constants. If one is able to derive them with a suitable mathematical model, independent of the cosmic redshift and CMBR observations, the future cosmic acceleration can be verified from atomic and nuclear physical constants.

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