Atom, Avogadro Number and Atomic Cosmology

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Abstract: If light is coming from the atomic matter of the galaxy, then the observed redshift can be interpreted as an index of the galactic atomic matter 'light emission mechanism'. Clearly speaking redshift may not be connected with 'galaxy receding'. The proposed basic idea is - during cosmic evolution, as age of the hydrogen atom increases, emitted photon energy increases. If so current cosmological changes may be reflected in any existing atom. At any given cosmic time, Hubble length can be considered as the gravitational or electromagnetic interaction range. By highlighting the six major shortcomings of modern cosmology, in this paper an attempt is made to verify the cosmic acceleration in a quantum mechanical approach. The four possible assumptions are : 1) Reduced Planck's constant increases with cosmic time. 2) Being a primordial evolving black hole and Hubble's constant being the angular velocity, universe is always rotating with light speed. 3) Atomic gravitational constant is squared Avogadro number times the classical gravitational constant and 4) Atomic gravitational constant or the classical gravitational constant shows discrete behavior. This may be the root cause of discrete nature of revolving electron's angular momentum. With reference to the present atomic and nuclear physical constants, obtained Hubble's constant is (67.88 to 71.41) km/sec/Mpc and is very close to the recommended value. This is a remarkable coincidence and seems to play a vital role in future unified physics.

Keywords: Reduced Planck's constant**;** Hubble length; Hubble mass; Hubble volume; Hubble density; Cosmic red shift; CMBR temperature; Avogadro number; Atomic gravitational constant;

1. INTRODUCTION

This paper is an updated version and a review of the authors recently published work 'Unified Concepts in Cosmic, Atomic and Nuclear Physics' [1]. 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) Confusion in 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 and so on [2-16].

Many physicists think about the possible variation of the 'fine structure ratio' and experiments are in progress. In a theoretical approach, a varying α has been proposed as a characteristic and unified way of solving problems in cosmology and astrophysics. More recently, theoretical interest in varying constants (not just α) has been motivated by string theory and other such proposals for going beyond the Standard Model of particle physics. In October 2011 Webb et al [17] reported a variation in α dependent on both 'redshift' and 'spatial direction'. Here it should be noted that, the concept - 'variation of alpha' directly and indirectly is giving a clue to think about the possible 'variation' of the reduced Planck's constant or Planck's constant. This is a very sensitive point and needs strong experimental evidence and vigorous theoretical analysis. But till today from ground based laboratory experiments no variation was noticed in the magnitude of the fine structure ratio. In this paper authors made an attempt to study this complicated issue in a theoretical way.

In understanding the basic concepts of unification or TOE, role of dark energy and dark matter is insignificant. Even though there were a number papers/books published on cosmology, the attempt for a comprehensive study on this subject, coupled with comparative studies with the modern cosmology on one hand and with the modern atomic physics on the other, was not made by anybody so far. The present study can be considered as a 'beginning project' in this field. Cosmological observations through ground telescope or satellite telescope is a normal practice. In this paper under consideration, it can be suggested that-current cosmological changes can be understood by studying the atom and atomic nucleus through ground based experiments. It is an interesting part of the study of cosmology and fundamental interactions. So far no institute has taken this subject for R&D. This idea is quite unique, natural and the openness in the subjects of cosmology and fundamental interactions can be eliminated. The future science generation can adopt this proposed concept as a characteristic reference for the future scientific observations, analysis and experiments. It is an interesting idea and 100 years of atomic, nuclear and cosmic physics can be refined and unified.

In between the 'flat' universe and the 'closed' universe, there is one compromise. That is 'Hubble volume'. 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 [12] 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, "within the Hubble volume, each and every point in free space is influenced by the Hubble mass". We begin this paper with the six major shortcomings of modern cosmology.

1.1 Major shortcomings of modern cosmology

A) If light is coming from the atomic matter of the galaxy, then redshift can be interpreted as an index of the galactic atomic matter 'light emission mechanism'. In no way it seems connected with 'galaxy receding'.

B) If cosmic expansion is continuous and accelerating and redshift is a measure of cosmic expansion, 'rate of increase in redshift' can be considered as a measure of cosmic 'rate of expansion'. Then there is no possibility to observe a 'constant' red shift. Merely by estimating galaxy distance (instead of estimating galaxy receding speed) one cannot verify the cosmic acceleration.

C) 'Drop in cosmic temperature' can be considered as a measure of cosmic expansion and 'rate of decrease in cosmic temperature' can be considered as a measure of cosmic 'rate of expansion'. But if rate of decrease in temperature is very small and is beyond the scope of current experimental verification, then the two possible states are: a) cosmic temperature is decreasing at a very slow rate and universe is expanding at a very slow rate and b) there is no 'observable' thermal expansion and there is no 'observable' cosmic expansion.

D) If 'Dark energy' is the major outcome of the 'accelerating universe', it is very important to note that - in understanding the basic concepts of unification or other fundamental areas of physics, role of dark energy is very insignificant.

E) So far no ground based experiment confirmed the existence of dark energy. There is no single clue or definition or evidence to any of the natural physical properties of (the assumed) dark energy.

F) Dimensionally it is possible to show that, the dimensions of Hubble's constant and angular velocity are same. If so considering Hubble's constant merely as an expansion parameter may not be correct.

1.2 Isotropy may be best possible in a closed expanding universe

If universe is really accelerating, based on the Hubble's law [2], 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'. It can be suggested that,

A) In a closed expanding universe, in tandem with expansion rate, instantaneously thermal waves undergo continuous stretching in all directions with respect to the center of the closed universe and the closed boundary .

B) When the expansion rate is very slow. i.e practically zero expansion rate, stretching in thermal waves is almost zero and one can observe uniform thermal wavelength in all directions.

C) In a flat universe, where there is no boundary and no center, it may not be possible.

1.3 Hubble's opinion on Cosmic redshift

In 1947 Hubble [3] suggested that "*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.*"

1.4 Einstein's opinion on unification of electromagnetic and gravitational interactions

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. [13,14]. 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. . In this paper authors made an attempt to understand the basic concepts of unification via particle cosmology [15,16].

1.5 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 [18]. Galaxies spin, stars spin, and planets spin. So, why not the whole universe? The consequences of a spinning universe seems to be profound [19-31], 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 (H_t) represents cosmological angular velocity. Assume that, a planet of mass (M) and size (R) rotates with angular velocity (ω_e) and linear velocity (v_e) 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,

$$\frac{1}{2}mv_e^2 = \frac{GMm}{R} \quad (1)$$

$$R\omega_e = v_e = \sqrt{\frac{2GM}{R}} \text{ and } \omega_e = \frac{v_e}{R} = \sqrt{\frac{2GM}{R^3}} \quad (2)$$

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, $M = \frac{4\pi}{3}R^3\rho_e$,

$$\omega_e = \frac{v_e}{R} = \sqrt{\frac{8\pi G\rho_e}{3}} \text{ Or } \omega_e^2 = \frac{8\pi G\rho_e}{3} \quad (3)$$

$$\text{Density, } \rho_e = \frac{3\omega_e^2}{8\pi G} \quad (4)$$

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 (4), it is very clear that, proportionality constant being $\frac{3}{8\pi G}$,

$$\text{density} \propto (\text{angular velocity})^2 \quad (5)$$

Equation (4) is similar to "flat model concept" of cosmic "critical density"

$$\rho_c = \frac{3H_t^2}{8\pi G} \tag{6}$$

Comparing equations (4) and (6) dimensionally and conceptually, i.e.

$$\rho_e = \frac{3\omega_e^2}{8\pi G} \text{ with } \rho_c = \frac{3H_t^2}{8\pi G} \tag{7}$$

$$H_t^2 \to \omega_e^2 \text{ and } H_t \to \omega_e \tag{8}$$

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' simply appears as the 'spherical volume density' of the closed and expanding universe.

2.0 POSSIBLE ASSUMPTIONS IN UNIFIED COSMIC PHYSICS

The possible assumptions in unified cosmic physics can be expressed in the following way [30-33],[34-50]:

A) Hubble length (c/H_t) can be considered as the gravitational or electromagnetic interaction range.

B) Being a primordial evolving black hole and angular velocity being H_t, universe is always rotating with light speed [30-34].

C) Atomic gravitational constant [38-50] is squared Avogadro number times the classical gravitational constant. Thus,

$$G_A \cong N^2 G \tag{9}$$

where (G_A) is the Atomic gravitational constant, (N) is the Avogadro number and (G) is the classical gravitational constant. Note that, (N^2) can be considered as the ratio of classical force limit (c^4/G) and weak force magnitude [40,44].

D) Atomic gravitational constant or the classical gravitational constant shows discrete behaviour as $(n.G_A)$ or $\left[N^2(n.G)\right]$ where $n = 1, 2, 3, ..$

E) Reduced Planck's constant increases with cosmic time [32].

Thus at any given cosmic time t,

1) $\frac{d(\hbar)}{dt}$ 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 [51,52].

2) 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.

3) The basic or original definition of present/current redshift (z_0) seems to be

$$z_0 \cong \frac{E_0 - E_G}{E_0} \cong \frac{\lambda_G - \lambda_0}{\lambda_G} \le 1 \text{ but not } z_0 \cong \frac{\lambda_G - \lambda_0}{\lambda_0}. \tag{10}$$

Here $E_0 \cong \frac{hc}{\lambda_0}$ is the energy of photon at our galaxy and $E_G \cong \frac{hc}{\lambda_G}$ is the energy of photon at the observed galaxy when it was emitted. Similarly 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, present red shift (z_0) will be directly proportional to our galaxy and observed galaxy age difference or time taken by light to reach our galaxy from the old galaxy (Δt). Thus $z_0 \propto \Delta t$ and

$$z_0 \cong H_0 \Delta t. \tag{11}$$

Here H_0 is the proportionality constant. In this way H_0 can be incorporated directly. Time taken by light to reach our galaxy or the age difference of our galaxy and observed galaxy can be expressed as,

$$\Delta t \cong \frac{z_0}{H_0}. \tag{12}$$

$$c\Delta t \cong z_0 \cdot \frac{c}{H_0}. \tag{13}$$

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.

Now the fundamental question to be answered is: If (h_t) takes the role of (h), how to define the red shift?. In section 3.7, considering $\left(\frac{E_0 - E_G}{E_0}\right)$ we proposed a simple solution to this problem. With different galaxies and with different (Δt),

$$H_0 \cong \left(\frac{z_0}{\Delta t}\right)_{G1} \cong \left(\frac{z_0}{\Delta t}\right)_{G2} \cong \left(\frac{z_0}{\Delta t}\right)_{G3} \qquad (14)$$

where $G1, G2, G3,..$ represents different galaxies. In an alternative way the authors propose the following concept- during cosmic evolution 'aged' Hydrogen atom emits energetic photon. Clearly speaking, as age of the hydrogen atom increases, it emits photon with increased quantum of energy. Thus past light quanta emitted from old galaxy will have less energy and show a red shift with reference to our galaxy. During journey light quanta will not lose energy and there will be no change in light wavelength.

4) At any given cosmic time, the Schwarzschild radius of universe is

$$\frac{2GM_t}{c^2} \cong \frac{c}{H_t} \qquad (15)$$

where M_t is the cosmic mass at that time. With this idea, at any given cosmic time, cosmic size can be constrained to a maximum instead of infinity. The cosmic mass can be expressed as

$$M_t \cong \frac{c^3}{2GH_t}. \qquad (16)$$

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

$$(\rho_v)_t \cong \frac{c^3}{2GH_t} \div \frac{4\pi}{3}\left(\frac{c}{H_t}\right)^3 \cong \frac{3H_t^2}{8\pi G}. \qquad (17)$$

It can be called as the cosmic Hubble density.

3.0 APPLICATIONS OF THE PROPOSED ASSUMPTIONS

Similar to and close to the Planck scale and with reference to the fundamental physical constants $(e \text{ and } G)$, a fundamental mass unit can be constructed as $(M_e)^{\pm} \cong \sqrt{\frac{e^2}{4\pi\epsilon_0 G}} \cong 1.859211\times10^{-9}$ kg. It can be considered as a characteristic fundamental unified charged mass unit. It is noticed that, the ratio $\left(\frac{M_t}{M_e}\right)$ plays a very interesting role in fitting the cosmic matter density and thermal energy density.

3.1 Cosmic Matter Density

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

$$(\rho_m)_t \cong \left[1+\ln\left(\frac{M_t}{M_e}\right)\right]^{-1}\left(\frac{3H_t^2}{8\pi G}\right) \qquad (18)$$

Note that, at present obtained matter density ρ_m can be compared with the elliptical and spiral galaxy matter density. Based on the average mass-to-light ratio for any galaxy [53]

$$(\rho_m)_0 \cong 1.5\times10^{-32}\eta h_0 \text{ gram/cm}^3 \qquad (19)$$

where for any galaxy, $\langle M/L\rangle_{Galaxy} = \eta\langle M/L\rangle_{\text{Sun}}$ and the number: $h_0 \cong \frac{H_0}{100 \text{ Km/sec/Mpc}} \cong \frac{70}{100} \cong 0.70$. 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 $(5.88 \text{ to } 6.6) \times 10^{-32}$ gram/cm^3.

3.2. Cosmic Thermal Energy Density

At any given cosmic time, if (a) is the radiation energy constant and (b) is the Wein's displacement constant, ratio of cosmic volume energy density and cosmic thermal energy can be expressed as

$$\left(\frac{\rho_v c^2}{aT^4}\right)_t \cong \left[1+\ln\left(\frac{M_t}{M_e}\right)\right]^2 \qquad (20)$$

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

$\cong 1.3333991714\cdot\frac{k_B}{b^3} \cong \frac{4}{3}\cdot\frac{k_B}{b^3}$. Thus in a classical approach, independent of the Planck's constant, radiation constant can. expressed as above. Even with reference to quantum mechanics also, 'Wein's constant' is a cosmological constant. This is a very sensitive point to be discussed. Wien's law is based on the classical approach [54,55]. 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 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. If so, at any given cosmic time, thermal energy density can be expressed as

$$aT_t^4 \cong \left[1+\ln\left(\frac{M_t}{M_e}\right)\right]^{-2}\left(\frac{3H_t^2c^2}{8\pi G}\right) \quad (21)$$

If H_0 is close to 70 km/sec/Mpc, obtained CMBR temperature [56,57] is 2.704 ^{0}K. Thus 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.

$$\left(\rho_m c^2\right)_t \cong \sqrt{\left(aT_t^4\right)\left(\frac{3H_t^2c^2}{8\pi G}\right)} \cong \sqrt{\left(aT^4\right)_t\left(\rho_v c^2\right)_t} \quad (22)$$

3.3. Wavelength of the CMB radiation

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

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

$$\left(\lambda_m\right)_t \cong \left(\frac{\rho_v}{\rho_m}\right)_t \frac{G\sqrt{M_tM_e}}{c^2} \cong \left[1+\ln\left(\frac{M_t}{M_e}\right)\right]\frac{G\sqrt{M_tM_e}}{c^2} \quad (23)$$

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: Pair particles creation and annihilation in 'free space'- is an interesting idea. In the expanding universe, by considering the proposed charged $\left(M_e\right)^{\pm}$ and its pair annihilation as a characteristic cosmic phenomena, origin of the isotropic CMB radiation can be addressed.. Thermal energy can be expressed as

$$k_BT_t \cong \sqrt{\frac{M_e}{M_t}}\cdot\left[\left(M_e\right)^+ + \left(M_e\right)^-\right]c^2 \cong \sqrt{\frac{M_e}{M_t}}\cdot 2M_ec^2 \quad (24)$$

Based on Wein's displacement law,

$$\left(\lambda_m\right)_t \cong \frac{b}{T_t} \cong \sqrt{\frac{M_t}{M_e}}\cdot\frac{bk_B}{2M_ec^2} \quad (25)$$

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 length obtained from methods-1 and 2, wave length of the most strongly emitted CMB radiation can be expressed as

$$\left(\lambda_m^2\right)_t \cong \left[1+\ln\left(\frac{M_t}{M_e}\right)\right]\cdot\left(\frac{M_t}{2M_e}\right)\cdot\left(\frac{bk_BG}{c^4}\right) \quad (26)$$

$$\left(\lambda_m\right)_t \cong \sqrt{\left[1+\ln\left(\frac{M_t}{M_e}\right)\right]\cdot\left(\frac{M_t}{M_e}\right)\cdot\left(\frac{bk_BG}{2c^4}\right)} \quad (27)$$

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,

$$\left(\lambda_m\right)_t \propto \sqrt{\left(\frac{\rho_v}{\rho_m}\right)_t} \propto \sqrt{1+\ln\left(\frac{M_t}{M_e}\right)} \quad (28)$$

$$\left(\lambda_m\right)_t \propto \sqrt{\frac{M_t}{M_e}} \quad (29)$$

and $\sqrt{\frac{bk_BG}{2c^4}} \cong 1.2856\times10^{-35}$ m seems to be a classical constant and can be considered as a characteristic classical thermal wave length. The most important point is that, as the black hole universe is expanding, its expansion rate can be verified with $\frac{d}{dt}\left(\lambda_m\right)_t$. 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.

3.4 About the cosmic time

At any given cosmic time t, it can be suggested that,

$$aT_t^4 \cong \left(\frac{R_t}{ct}\right)\cdot\left(\frac{3H_t^2c^2}{8\pi G}\right) \cong \frac{3H_tc^2}{8\pi G\cdot t} \quad (30)$$

Here, $R_t \cong \frac{c}{H_t} \cong \frac{2GM_t}{c^2}$ is the cosmic radius at time t and (ct) is the imaginary distance travelled by light in time t.

From relation (21)

$$\left(\frac{ct}{R_t}\right) \cong \left(t.H_t\right) \cong \left(\frac{3H_t^2c^2}{8\pi G}\right) \cong \left[1+\ln\left(\frac{M_t}{M_e}\right)\right]^2 \quad (31)$$

In this way this proposal differs from the existing concept of $\left(t.H_t\right)\cong 1$. Theoretically it is a very sensitive problem whether to 'consider' or 'not to consider' the density ratio

$\left(\frac{3H_t^2c^2}{8\pi G}\right)$. When $M_t \cong M_e \cong \sqrt{\frac{e^2}{4\pi\epsilon_0 G}}$, $aT_e^4 \cong \left(\frac{3H_e^2c^2}{8\pi G}\right)$, $ct_e \cong R_e$ and $t_e \cong \frac{1}{H_e} \cong \frac{2GM_e}{c^3} \cong 9.211\times 10^{-45}$ sec. Present, cosmic time can be obtained as

$$t_0 \cong \frac{3H_0c^2}{8\pi GaT_0^4} \cong \left(\frac{3H_0^2c^2}{8\pi GaT_0^4}\right)\cdot\left(\frac{1}{H_0}\right) \cong 277 \text{ trillion years.} \quad (32)$$

3.5 . The Cosmological Fine Structure Ratio

In physics, the fine-structure ratio (α) is a fundamental physical constant, namely the coupling constant characterizing the strength of the electromagnetic interaction. Being a dimensionless quantity, it has constant numerical value in all systems of units. If $\left(\rho_v c^2\right)_0$ is the present cosmic volume energy density and aT_0^4 is the present cosmic thermal energy density, it is noticed that,

$$\ln\sqrt{\left(\frac{aT^4}{\rho_v c^2}\right)_0 \cdot \frac{4\pi\epsilon_0 GM_0^2}{e^2}} \cong \left(\frac{1}{\alpha}\right) \quad (33)$$

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. At present above relation takes the following form.

$$\ln\sqrt{\frac{2\pi}{3}\cdot\frac{4\pi\epsilon_0 aT_0^4c^4}{e^2H_0^4}} \cong \frac{1}{\alpha} \quad (34)$$

At present if observed CMBR temperature is $T_0 \cong 2.725\ ^0$K, obtained $H_0 \cong 71.415$ Km/sec/Mpc. After simplification, it can be interpreted as follows. Total thermal energy in the present Hubble volume can be expressed as,

$$\left(E_T\right)_0 \cong aT_0^4\cdot\frac{4\pi}{3}\left(\frac{c}{H_0}\right)^3 \quad (35)$$

If $\left(\frac{c}{H_0}\right)$ is the present electromagnetic interaction range, the present electromagnetic potential can be expressed as

$$\left(E_e\right)_0 \cong \frac{e^2}{4\pi\epsilon_0\left(c/H_0\right)} \quad (36)$$

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

$$\left(\frac{1}{\alpha}\right)_0 \cong \ln\sqrt{\frac{\left(E_T\right)_0}{2\left(E_e\right)_0}} \quad (37)$$

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. Thus at any cosmic time,

$$\left(\frac{1}{\alpha}\right)_t \cong \ln\sqrt{\frac{\left(E_T\right)_t}{2\left(E_e\right)_t}} \quad (38)$$

When, $M_t \rightarrow M_e$ and $\left(aT_t^4\right) \rightarrow \frac{3H_t^2c^2}{8\pi G}$, $\left(\frac{1}{\alpha}\right)_t \rightarrow 0$. In this way, in a unified manner, the present fine structure ratio can be fitted. From this relation it is possible to say that, cosmological rate of change in fine structure ratio, $\frac{d}{dt}\left(\frac{1}{\alpha}\right)$ may be considered as an index of the future cosmic acceleration. Many physicists think it's possible variation and experiments are in progress. Specifically, a varying α has been proposed as a way of solving problems in cosmology and astrophysics. More recently, theoretical interest in varying constants (not just α) has been motivated by string theory 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 [17]. Till today from ground based laboratory experiments no variation was noticed in the magnitude of the fine structure ratio. Semi empirically to a good approximation, it is noticed that,

$$\frac{1}{\alpha_t} \cong \ln\left(\frac{x}{1+\ln(x)}\right) \quad (39)$$

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 close to 71.75 km/sec/Mpc.

3.6. The Cosmological Reduced Planck's Constant

From above relations at any time $(1/\alpha)_t$ can be estimated and thus the cosmological reduced Planck's constant can be obtained with the existing definition,

$$\hbar_t \equiv \frac{1}{\alpha_t} \cdot \frac{e^2}{4\pi\epsilon_0 c} \tag{40}$$

With this idea, magnetic moments of electron, neutron and proton can be expressed as

$$\mu_m \cong \left(\frac{x}{\alpha_0}\right) \cdot e \cdot c. \left(\frac{e^2}{4\pi\epsilon_0 mc^2}\right) \tag{41}$$

where x is a factor to be determined. In case of electron, $x \cong \frac{1}{2}$, for neutron, $x \cong 1$, and for proton, $x \cong \sqrt{2}$. From above relations it can be guessed that, there exists a strong interconnection in between universe and the Hydrogen atom. With many numerical coincidences it is noticed that,

$$\hbar_0 \cong \sqrt{\frac{M_0}{m_e}} \cdot \frac{G m_p m_e}{c} \tag{42}$$

Here (M_0/m_e) can be considered as the number of electrons in the present universe of mass, $M_0 \cong \left(c^3/2GH_0\right)$.

If so, present Hubble's constant can be expressed as

$$H_0 \cong \frac{G m_p^2 m_e c}{2\hbar_0^2} \cong 70.743 \text{ km/sec/Mpc} \tag{43}$$

Thus it is possible to guess that,

$$H_0 \hbar_0^2 \cong H_t \hbar_t^2 \cong \frac{G m_p^2 m_e c}{2} \cong \text{constant} \tag{44}$$

Another very interesting relation is

$$\hbar_0 \cong \left(\frac{2Gm_p}{c^2 R_p}\right) \cdot \frac{m_e c^2}{H_0} \cong \frac{2G m_p m_e}{R_p H_0} \tag{45}$$

Note that here, (R_p) is the 'rms' radius of proton [58- 62].

If electron revolves round the proton, this expression can be given a chance. The two best quoted values of the rms radius of proton are 0.87680(690)fm and 0.84184(67) fm [58, 59]. If so, present Hubble's constant can be expressed as

$$H_0 \cong \frac{2G m_p m_e}{R_p \hbar_0} \cong (67.88 \text{ to } 70.69) \text{ km/sec/Mpc} \tag{46}$$

If $R_p \cong 0.84184(67)$ fm $\to$ $H_0 \cong 70.69$ km/sec/Mpc and if $R_p \cong 0.87680$ fm $\to$ $H_0 \cong 67.88$ km/sec/Mpc. This can be compared with the recent value (67.80 ± 0.77) km/s/Mpc. recommended by Ade, P. A. R.; Aghanim, N.; Armitage-Caplan, C.; et al. [57] on 21 March 2013. Another characteristic and interesting relation is

$$h_t H_t \cong h_0 H_0 \quad \text{or} \quad \hbar_t H_t \cong \hbar_0 H_0 \tag{47}$$

Now from relations (37) and (39)

$$\hbar_0 \cong \left(\frac{4GM_0}{c^2 R_p}\right) \cdot \frac{G m_p m_e}{c} \tag{48}$$

$$\frac{\hbar_0}{2} \cong \left(\frac{2GM_0}{c^2 R_p}\right) \cdot \frac{G m_p m_e}{c} \cong \left(\frac{R_0}{R_p}\right) \cdot \frac{G m_p m_e}{c} \tag{49}$$

where $R_0 \cong \frac{c}{H_0} \cong \frac{2GM_0}{c^2}$. Please note that no arbitrary parameter is involved in this expression. From unification point of view this can be given a chance.

Discrete nature of $(\hbar)$ can be obtained by considering $(n.m_p)$ or $(n.G)$ where $n = 1, 2, 3..$. Compared to $(n.m_p)$, $(n.G)$ seems to be practical. It directly leads to 'quantum gravity'. Then the discrete nature of the proposed atomic gravitational constant can be expressed as $\left[N^2 (n.G)\right]$. Anyhow, it has to be discussed in depth. From relation (45) fine structure ratio can be expressed as

$$\frac{1}{\alpha_0} \cong \left(\frac{2Gm_p}{c^2 R_p}\right) \cdot \left(\frac{e^2}{4\pi\epsilon_0 m_e c^2}\right)^{-1} \left(\frac{c}{H_0}\right) \tag{50}$$

Here $\left(\frac{e^2}{4\pi\epsilon_0 m_e c^2}\right)$ is the classical radius of electron and (c/H_0) is the assumed present gravitational and electromagnetic interaction range.

In this paper we are showing the different possible ways fitting the Planck's constant. Whether it follows a 'natural logarithmic relation' or a 'linear relation' – to be confirmed. Now the fundamental question to be answered is- How $(\hbar_t)$ varies with time? Answer can be obtained by analysing all the above relations. It has be verified from the past and future 'galaxy age and redshift' data analysis.

3.7. Electron's Characteristic Potential Energy and the cosmic red shift

In Hydrogen atom, by trial-error, it is noticed that,

$$\left(\frac{e^2}{4\pi\epsilon_0 G_A m_e^2}\right)\sqrt{\frac{\sqrt{m_p m_e^3}}{2}}.c^2 \cong \alpha^2 m_e c^2 \tag{51}$$

This is an observation. Here, LHS = 27.356 eV and RHS = 27.21138 eV. Here error is 0.5315%. Thus in hydrogen atom potential energy of electron can be expressed as

$$E_{pot} \cong -\left[\left(\frac{e^2}{4\pi\epsilon_0 G_A m_e^2}\right)\sqrt{\frac{\sqrt{m_p m_e^3}}{2}}.c^2\right]^2 \div \alpha_0^2 m_e c^2 \tag{52}$$

On simplification and considering the assumed variable nature of $(\hbar_t)$, above expression takes the following simple form.

$$\left(E_{pot}\right)_0 \cong -\left(\frac{\hbar_0 c}{G_A m_e^2}\right)^2 \cdot \frac{\sqrt{m_p m_e}\cdot c^2}{2} \tag{53}$$

Here error is 0.3177%. With reference to the error bars [58] in the magnitudes of (N,G), this relation can be given a chance. If total energy is half of the potential energy, at present, in hydrogen atom, electron's characteristic discrete total energy [48,49] can be expressed as

$$\left(E_{total}\right)_0 \cong -\left(\frac{\hbar_0 c}{(n.G_A)m_e^2}\right)^2 \cdot \frac{\sqrt{m_p m_e}\cdot c^2}{4} \tag{54}$$

where n =1,2,3,..At any given cosmic time,

$$\left(E_{total}\right)_t \cong -\left(\frac{\hbar_t c}{(n.G_A)m_e^2}\right)^2 \cdot \frac{\sqrt{m_p m_e}\cdot c^2}{4} \tag{55}$$

Thus it can be suggested that, $E_{total} \propto \hbar_t^2$. Please note that, from Bohr's theory of hydrogen atom, $E_{total} \propto \frac{1}{\hbar_0^2}$. Authors are working on this conceptual variance. Solution mainly depends upon the 'origin' of $(\hbar)$ and it takes some time to resolve the issue. Now with reference to Bohr's second postulate, in the past, at any galaxy, emitted photon energy can be expressed as

$$\left(E_{Pho}\right)_G \cong \left(\frac{\hbar_t c}{G_A m_e^2}\right)^2 \cdot \frac{\sqrt{m_p m_e}\cdot c^2}{4}\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right) \cong \frac{h_t c}{\lambda_G} \tag{56}$$

$$\left(E_{Pho}\right)_G \cong \left(\frac{\hbar_t}{\hbar_0}\right)^2\left(\frac{\hbar_0 c}{G_A m_e^2}\right)^2 \cdot \frac{\sqrt{m_p m_e}\cdot c^2}{4}\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)$$

where $n_2 > n_1$ .At present emitted photon energy can be expressed as

$$\left(E_{Pho}\right)_0 \cong \left(\frac{\hbar_0 c}{G_A m_e^2}\right)^2 \cdot \frac{\sqrt{m_p m_e}\cdot c^2}{4}\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right) \cong \frac{h_0 c}{\lambda_0} \tag{57}$$

Now for any quantum jump, in the past it can be shown that,

$$\hbar_t \cong 4\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)^{-1}\left(\frac{G_A^2 m_e^4}{c^3 \lambda_G \sqrt{m_p m_e}}\right) \tag{58}$$

Corresponding to this obtained $\hbar_t$, from the relation $\hbar_t H_t \cong \hbar_0 H_0$ its corresponding H_t can be estimated. From H_t and from relations (21) or (27) corresponding CMBR temperature can be estimated. Thus for any galaxy, where $\hbar_t$ was playing a key role, corresponding present cosmic red shift can be expressed as

$$z_0 \cong \frac{\left(E_{Pho}\right)_0 - \left(E_{Pho}\right)_G}{\left(E_{Pho}\right)_0} \cong 1-\left(\frac{\hbar_t}{\hbar_0}\right)^2 \tag{59}$$

Now, approximately from relation (12) time taken by light to travel from observed galaxy to our galaxy or the age difference of our galaxy and the observed galaxy can be expressed as

$$\Delta t \cong \frac{z_0}{H_0} \cong \left[1-\left(\frac{\hbar_t}{\hbar_0}\right)^2\right]\frac{1}{H_0} \tag{60}$$

Obtained Δt has to be verified with other developed absolute methods of galaxy age estimation. If present redshift approaches unity, it can be suggested that, even though present cosmic time is 272 trillion years, our galaxy can not receive a light that was emitted prior to $\frac{1}{H_0}$ from the beginning of cosmic evolution.

3.8. Bohr radius of hydrogen atom

From above relations, at present Bohr radii in hydrogen atom can be expressed as

$$a_n \cong \left(\frac{(n.G_A)m_e^2}{\hbar_0 c}\right)^2 \cdot \frac{2e^2}{4\pi\epsilon_0\sqrt{m_p m_e}c^2} \tag{61}$$

Clearly writing,

$$a_n \propto \frac{e^2}{4\pi\epsilon_0} \quad (62)$$

$$a_n \propto \frac{1}{\frac{1}{2}\sqrt{m_p m_e c^2}} \quad (63)$$

$$a_n \propto \left(\frac{(n.G_A)m_e^2}{\hbar_0 c}\right)^2 \quad (64)$$

4.0 ROLE OF (N^2) AND (H_0) IN ATOMIC AND NUCLEAR PHYSICS

4.1 To fit the rms radius of proton

With reference to the 'rms' radius of proton [58,59], it is noticed that,

$$R_p \cong \sqrt{\frac{m_p}{M_e}} \cdot \frac{2G_A m_p}{c^2} \cong \left(\frac{4\pi\epsilon_0 G m_p^2}{e^2}\right)^{\frac{1}{4}} \cdot \frac{2G_A m_p}{c^2} \quad (65)$$

$$\cong 0.854531 \text{ fm}$$

where $M_e \cong \sqrt{\frac{e^2}{4\pi\epsilon_0 G}}$. Note that, no arbitrary parameter is involved in this relation. Obtained value is very close to the recommended 'rms' radius of proton. This proposal may be given a chance. Any how here it is a must to justify the role of the ratio (m_p/M_e). But its interpretation seems to be very complicated. Authors are working on this coincidence. The two important observations are, 1) Schwarzschild radius of proton where the operating gravitational constant is (N^2G) and 2) Gravitational and electromagnetic force ratio of proton where the operating gravitational constant is (G).

4.2 To fit the present Hubble's constant

From relations (46) and (65)

$$\hbar_0 \cong \sqrt{\frac{M_e}{m_p}} \cdot \frac{1}{N^2} \cdot \frac{m_e c^2}{H_0} \cong \left(\frac{e^2}{4\pi\epsilon_0 G m_p^2}\right)^{\frac{1}{4}} \cdot \frac{1}{N^2} \cdot \frac{m_e c^2}{H_0} \quad (66)$$

From this compound relation, (G) or (H_0) or (N) can be estimated in a unified manner.

$$\frac{1}{\alpha_0} \cong \sqrt{\frac{M_e}{m_p}} \cdot \frac{1}{N^2} \cdot \left(\frac{e^2}{4\pi\epsilon_0 m_e c^2}\right)^{-1} \left(\frac{c}{H_0}\right) \quad (67)$$

With reference to relation (65) present magnitude of Hubble's constant can be expressed as

$$H_0 \cong \left(\frac{e^2}{4\pi\epsilon_0 G m_p^2}\right)^{\frac{1}{4}} \cdot \frac{1}{N^2} \cdot \frac{m_e c^2}{\hbar_0} \quad (68)$$

$\cong 2.256928 \times 10^{-18}$ rad/sec $\cong 69.642$ km/sec/Mpc. This can be compared with the recent value (recommended by C. L. Bennett et al [56] on 20 December 2012) $H_0 \cong (69.32 \pm 0.80)$ km/sec/Mpc. This is a remarkable coincidence and seems to play a vital role in future unified physics.

DISCUSSION & CONCLUSIONS

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. With the proposed concepts and with the advancing science and technology, from the ground based laboratory experiments, from time to time the concept $d(\hbar_t)/dt$ can be put for experimental tests. There is no need to design a new experiment. Well established experiments are already available by which Planck's constant can be estimated.

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.

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. Considering the proposed relations and concepts it is possible to say that there exists a strong relation between cosmic Hubble mass, Avogadro number and unification. Now the new set of proposed relations are open to the science community. Whether to consider them or discard them depends on the physical interpretations, logics, experiments and observations. The mystery can be resolved only with further research, analysis, discussions and encouragement.

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