Review Article

Basics of black hole cosmology – first critical scientific review

Abstract: Considering 'black hole geometry' as the 'eternal cosmic geometry' and by assuming 'constant light speed rotation' throughout the cosmic evolution, at any time the currently believed cosmic 'critical density' can be shown to be the cosmic black hole's eternal 'volume density'. Thinking in this way and based on the Mach's principle, 'distance cosmic back ground' can be quantified in terms of 'Hubble volume' and 'Hubble mass'. To proceed further the observed cosmic redshift can be reinterpreted as an index of 'cosmological' light emission mechanism. By considering the characteristic mass unit $M_C \cong \sqrt{e^2/4\pi\varepsilon_0 G}$ as the initial mass of the baby cosmic black hole, initial physical and thermal parameters of the cosmic black hole can be defined and current physical and thermal parameters of the cosmic black hole can be fitted and understood. It can be argued that, there exists one variable physical quantity in the presently believed atomic and nuclear physical constants and "rate of change" in its magnitude can be considered as a 'standard or true measure' of the present 'cosmic rate of expansion'. In view of the confirmed zero rate of change in inverse of the Fine structure ratio (from the ground based laboratory experimental results) and zero rate of change in the current CMBR temperature (from satellite data) it can be suggested that, current cosmic expansion is almost all saturated and at present there is no significant cosmic expansion and there is no significant cosmic acceleration. Note that in Big bang model, confirmation of all the observations directly depend on the large scale galactic distances that are beyond human reach and raise ambiguity in all respects. The subject of modern black hole physics is absolutely theoretical. Advantage of Black hole cosmology lies in confirming its validity through the ground based atomic and nuclear experimental results! Finally it is possible to show that, quantum mechanics is a branch of 'Black hole cosmology'. Uncertainty relation and all other microscopic physical constants play a crucial role in understanding the halt of the present cosmic expansion.

Keywords: Mach's principle, Hubble volume**,** Hubble mass, Black hole cosmology, CMBR energy density, Planck's constant, Fine structure ratio, Cosmic Redshift, Hubble potential, Cosmological discrete light emission mechanism, Cosmic time, Nuclear charge radius, Unification.

1. Introduction

Black hole physicists assume that 'event horizon' is the area around a black hole that is, essentially, the 'point of no return', as light and matter cannot escape due to gravitational pull. The current black hole physics is totally based on the following tasks: How a black hole will be formed? How the primordial cosmic conditions influence the formation of early black holes? How the exterior part of black hole will behave around the black hole event horizon? How matter and information will escape from the (assumed) Black hole event horizon? How long a black hole will survive? Being the central part of galaxy how a black hole will grow? etc. Please note that, regarding black holes so far the non-addressed fundamental questions can be stated as follows. 1) What are the basic constituents of a black hole? Inside a black hole is there any independent existence to quantum mechanics? What happens inside a black hole? If black hole mass is too high and density is too low then how a black hole will be stable? Density being too low and without collapsing on its extraordinary weight, how a super massive black hole will control the whole galaxy for years? The subject of modern black hole physics is absolutely theoretical. With current technology for any human being or any artificial satellite reaching any black hole 'event horizon' is beyond the scope of possibility. If so, thinking about black hole's interior seems to be a case of academic interest only. At this critical juncture after 40 years of immense effort most recently Hawking [1] says that: "event horizons do not exist. The absence of event horizons means that there are no black holes - in the sense of regimes from which light can't escape to in infinity. There are however apparent horizons which persist for a period of time. This suggests that black holes should be redefined as meta-stable bound states of the gravitational field. A full explanation of the process would require a theory that successfully merges gravity with the other fundamental forces of nature. The correct treatment, however, remains a mystery". Here it may be noted that Hawking arrived at this proposal based on mathematics and reasoning but not with the 'real data'. However in this regard Polchinski [2] is skeptical that black holes without an event horizon could exist in nature. Really it is a very big shocking and confusing news to whole science community and millions of young and aged astrophysicists. 13 years ago Abhas Mitra [3] had shown that true Black Holes can never form. The so-called Black Holes observed by astronomers are actually radiation pressure supported Eternally Collapsing Objects (ECOs). These balls of fire are so hot that even neutrons and protons melt there and whose outward radiation pressure

balances the inward pull of gravity to arrest a catastrophic collapse before any Black Hole or 'singularity' would actually form. Most surprising thing is that Hawking has now only arrived at the similar conclusion as proposed by Abhas Mitra. Similarly Stephen Crothers [4] argues that, the black hole, which arises solely from an incorrect analysis of the Hilbert solution, is based upon a misunderstanding of the significance of the coordinate radius r. This quantity is neither a coordinate nor a radius in the gravitational field and cannot of itself be used directly to determine features of the field from its metric. The appropriate quantities on the metric for the gravitational field are the proper radius and the curvature radius, both of which are functions of r. The variable r is actually a Euclidean parameter which is mapped to non-Euclidean quantities describing the gravitational field, namely, the proper radius and the curvature radius. From these points it is very clear that, our current knowledge on black hole physics is not sufficient to make any comment and not sufficient to take any decision on black holes. One must wait for the ongoing and future research and analysis.

By any reason - based on either academic interest or scientific interest, if one wants to know something about the 'reality of existence' of black holes there is one possibility. That is the famous 'Hubble volume'. Based on the famous Mach's principle and with a probability of at least 1%, if it is assumed that, all the intellectual things, observable things and measurable things are part of the evolving and growing cosmic black hole then this simple idea will certainly raises many questions on our understanding of the current physics and validity of current physical laws. Cosmologists have noted for years that, when taken as a whole, the parameters (such as mass density, temperature, etc.) are consistent with the parameters of a black hole. Some have gone so far as to suggest, then, that the black holes, the super massive ones at least, in our own galaxy could be gateways into other galaxies contained within. 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. Whether it is really speculative or really true - to be decided by future science and technology. 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 $(4\pi/3)(c/H_0)^3$. In a universe with constant Hubble parameter, light emitted at the present time by objects outside the Hubble length would never be seen by an observer on Earth. That is, Hubble length would coincide with a cosmological event horizon (a boundary separating events visible at some time and those that are never visible). Another interesting observation is that, at any given cosmic time, the product of 'critical density' and 'Hubble volume' gives a characteristic cosmic mass and it can be called as the 'Hubble mass'. Schwarzschild radius of the 'Hubble mass' again matches with the 'Hubble length'. Most of the cosmologists believe that this is merely a coincidence. Here the authors emphasize the fact that this coincidence is having deep connection with cosmic geometry and the cosmological and microscopic physical phenomena [5,6,7].

Understanding and connecting 'tiny atom' and the 'gigantic universe' is really a very big challenging task. Bringing different branches of basic physics into 'Single frame' is a very tough job. By considering the growing Hubble volume as the volume of a primordial growing black hole, in this paper the authors proposed different applications of the Hubble volume and Hubble mass in cosmology as well as in microscopic physics. It is very clear to say that, advantage of Black hole cosmology lies in confirming its validity through the ground based atomic and nuclear study and experiments! With vigorous advanced mathematics some of the cosmologists are able to show that observed universe is a black hole. To understand and confirm this idea it can be suggested that, there exists one variable physical quantity in the presently believed atomic and nuclear physical constants and 'rate of change' in its magnitude can be considered as a "standard or true measure" of the present "cosmic rate of expansion". At any given cosmic time, 'Hubble length' can be considered as the gravitational or electromagnetic interaction range. If one is willing to think in this direction, by increasing the number of applications of 'Hubble mass' and 'Hubble volume' in other areas of fundamental physics like quantum physics, nuclear physics, atomic physics and particle physics slowly and gradually - in a progressive way, concepts of 'Black hole Cosmology' can be strengthened and can also be confirmed [8-20]. If so certainly 'Hubble mass' can be given more significance and top priority compared to the mysterious 'dark energy'. To proceed further and show that the universe is a growing black hole, in the following section the authors made an attempt to highlight the following 28 major short comings of modern big bang cosmology.

In our daily life generally it is observed that any animal or fruit or human beings (from birth to death) grows with closed boundaries (irregular shapes also can have a closed boundary). An apple grows like an apple. An elephant grows like an elephant. A plant grows like a plant. A human being grows like a human being. Throughout their life time they won't change their respective identities. These are observed facts. From these observed facts it can be suggested that "growth" or "expansion"' can be possible with a closed boundary. Thinking that nature loves symmetry, in a heuristic approach in this paper authors assume that "throughout its life time universe is a primordial black hole". Even though it is growing, at any time it is having an event horizon with a closed boundary and thus it retains her identity as a black hole forever. Note that universe is an independent body. It may have its own set of laws. At any time to maintain a closed boundary to have its size minimum- universe may be following the 'Schwarzschild radius'. If 'black hole geometry' is more intrinsic compared to the black hole 'mass' and 'density' parameters, if universe constitutes so many galaxies and if each galaxy constitutes a

central growing and fast spinning black hole then considering universe as an 'evolving and light speed rotating primordial black hole' may not be far away from reality. If universe is having no black hole geometry - any massive body (which is bound to the universe) may not show a black hole structure. That is black hole structure or geometry may be a subset of the cosmic geometry. This idea may be given a chance [21,22].

2. Major shortcomings of modern big bang cosmology

1) It may be noted that, increased redshifts and increased distances forced Edwin Hubble to propose the Hubble's law [23,24]. In fact there is no chance or scope or place for 'galaxy receding'. It is only our belief in its 'given' (Doppler shift based) interpretation. Even then, merely by estimating galaxy distance and without measuring galaxy receding speed, one cannot verify its acceleration. Clearly speaking: two mistakes are possible here. i) Assumed galaxy receding speed is not being measured and not being confirmed. ii) Without measuring and confirming the galaxy receding speed, how can one say and confirm that it (galaxy) is accelerating. It is really speculative.
2) If light is coming from the atoms of the gigantic galaxy, then redshift can also be interpreted as an index of the galactic cosmological atomic 'light emission mechanism'. In no way it seems to be connected with 'galaxy receding'.
3) According to the modern cosmological approach, bound systems like 'atoms' which are found to be the major constituents of galactic matter - will not change with cosmic expansion/acceleration. As per the present observational data this may be true. But it might be the result of ending stage of cosmic expansion. As the issue is directly related with unification it requires lot of research in basic physics to confirm. In this regard, without considering and without analysing the past data, one can not come to a conclusion. If one is willing to think in this direction observed galactic redshift data can be considered for this type of new analysis.
4) Without a proper confirmation procedure for the absolute cosmic expansion and guessing that current universe is expanding - cosmologists proposed and confirmed the existence of dark energy indirectly. It may not be reasonable. Quantitatively or at least qualitatively standard model of cosmology does not throw light on the generation and (normal) physical properties of 'dark energy'.
5) The standard Big Bang model tells us that the Universe exploded out of an infinitely dense point. But nobody knows what would have triggered this outburst: the known laws of physics cannot tell us what happened at that moment.
6) Really if there was a 'big bang' in the past, with reference to formation of the big bang as predicted by general theory of relativity and with reference to the cosmic expansion that takes place simultaneously in all directions at a uniform rate at that time about the point of big bang - 'point' of big bang can be considered as the centre or characteristic reference point of cosmic expansion in all directions. In this case, saying that there is no preferred direction in the expanding universe - may not be correct.
7) Either in the big bang or in the inflation, quantification of the initial assumed conditions seem to be poor, unclear and not linked with fundamental constants. The earliest phases of the Big Bang are subject to much speculation and inflation requires 'fine tuning'.
8) Standard cosmology does not give information on the origin of 'inflation'. Inflation is often called a period of accelerated expansion. With respect to 'no hair theorem' some similarities are there for cosmic inflation and black holes. Conceptually 'inflation' can be accommodated in any model of cosmology like open model or closed model.
9) A key requirement is that inflation must continue 'long enough' to produce the present observable universe from a single, small inflationary Hubble volume. Assuming a rapid rate of cosmic expansion and steady rate of time may not be reasonable. If space-time is interrelated then 'space' and 'time' both should simultaneously follow the momentary rapid exponential expansion. For example if space expands by a factor 10^{26} in size within a very 'short span', cosmic time should also increase in the same proportion. 'Time' seems to be a silent observer in the presently believed 'cosmic inflation'. It may not be reasonable.
10) There is no scientific evidence for the Friedmann's second assumption. We believe it only on the grounds of modesty [25].
11) Dimensionally it is perfectly 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. Please see the section-5.
12) Even though it was having strong footing, Mach's principle [26] was not implemented successfully in standard cosmology. Clearly speaking the term "distance cosmic back ground" is not being defined and not being quantified in a physical approach.
13) At any given cosmic time, the product of 'critical density' and 'Hubble volume' gives a characteristic cosmic mass and it can be called as the 'Hubble mass'. Interesting thing is that, Schwarzschild radius of the 'Hubble mass' again matches with the 'Hubble length'. Most of the cosmologists believe that this is merely a coincidence. Here the

researchers emphasize the fact that this coincidence is having deep connection with cosmic geometry and the cosmological physical phenomena.

14) Somehow and by any reason, magnitude of the current Hubble mass being the same, hypothetically if volume density approaches the current matter density, then Hubble length increases by a factor ~5. Similarly if volume density approaches the current thermal energy density, then Hubble length increases by a factor ~27. These two numbers can be compared with the presently believed first two of the three cosmological numbers 4.9%, 26.8% and 68.3%. Based on this coincidence and as the currently believed third number ~68% is obtained from the relation (100-(4.9+26.8))%, its proposed existence seems to be ad-hoc.
15) If 'Planck mass' is the characteristic beginning 'mass scale' of the universe, then by substituting the geometric mean mass of the present Hubble mass and the Planck mass in the famous Hawking's black hole temperature formula automatically the observed 2.725 K can be fitted very accurately [6,7]. Standard cosmology is not throwing any light on this surprising coincidence.
16) If cosmic expansion is continuous and accelerating and redshift is a measure of cosmic expansion, then '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. More over the current definition of red shift seems to be ad-hoc and not absolute. Please see section- 4. Hence one may not be able to understand or confirm the actual cosmic rate of expansion.
17) Even though the whole physics strictly follows the 'constancy of speed of light', cosmic acceleration seems to violate it. This is really doubtful.
18) 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.
19) If observed cosmic microwave back ground radiation temperature is 2.725 K and is very low in magnitude and is very close to absolute zero, then thinking about and confirming the 'cosmic acceleration' may not be reasonable.
20) In the standard model of cosmology, there is no clear cut information about the 'uniqueness' of the assumed 'dark energy'. If its identification is not unique in nature, then different cosmology models can be developed with different forms of 'dark energy'. If so understanding the absolute cosmic expansion rate with dark energy seems to be doubtful.
21) So far no ground based experiment confirmed the existence of dark energy. There is no single clue or evidence to any of the natural physical properties of (the assumed) dark energy.
22) 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.
23) If existence of dark energy is true and dark energy is supposed to have a key role in the past and current cosmic expansion, then it must have also played a key role in the beginning of cosmic evolution. In this regard no information is available in standard cosmology.
24) Standard model of cosmology does not throw light on the generation and existence of atomic physical constants like Planck's constant, reduced Planck's constant, inverse of fine structure ratio and nuclear charge radius etc. Clearly speaking synthesis of elementary physical constants seem to be more important than the cosmological nucleosynthesis.
25) General theory of relativity does not throw any light on the 'mass generation' of charged particles. It only suggests that space-time is curved near the massive celestial objects. More over it couples the cosmic (dust) matter with geometry. But how matter/dust is created? Why and how elementary particle possesses both charge and mass? Such types of questions are not being discussed in the frame work of general relativity.
26) Standard model of cosmology does not throw light on the charge-mass unification scheme of atomic particles. The main object of unification is to understand the origin of elementary particles rest mass, magnetic moments and their forces. Right now and till today 'string theory' with 4 + 6 extra dimensions is not in a position to explain the unification of gravitational and non-gravitational forces. More clearly speaking it is not in a position to merge the Planck scale and cosmic scale with the characteristic nuclear scale.
27) Either general theory of relativity or standard cosmology does not give any information on the applications of the classical force limit $\left(c^4/G\right)$ and the classical power limit $\left(c^5/G\right)$. Compared to the hypothetical 'dark energy', with a coefficient of unity, $\left(c^4/G\right)$ can be considered as the cosmic vacuum force and $\left(c^5/G\right)$ can be considered as the cosmic vacuum power.
28) In Big bang model, confirmation of all the observations directly depend on the large scale galactic distances that are beyond human reach and raise ambiguity in all respects. The subject of modern black hole physics is absolutely theoretical. Advantage of Black hole cosmology lies in confirming its validity through the ground based atomic and nuclear experimental results.

If one is willing to think in this new direction, certainly other hidden short comings can also be surfaced out. Most of the modern cosmologists are enforced with 85 years old Hubble's interpretation. This is the time to re-interpret the Hubble's law and to revise the basics of modern cosmology. Based on the proposed short comings the concepts of 'big bang cosmology' can be relinquished and Black hole cosmology can be invoked for in-depth discussion

3. The proposed picture of black hole cosmology

In order to understand and establish the basics of black hole cosmology, the authors first made an attempt in finding and collecting the related information from current research news.

1. Most recently Michael E. McCulloch says [12]: For an observer in an expanding universe there is a maximum volume that can be observed, since beyond the Hubble distance the velocity of recession is greater than the speed of light and the redshift is infinite: this is the Hubble volume. Its boundary is similar to the event horizon of a black hole because it marks a boundary to what can be observed. This means that it is reasonable to assume that Hawking radiation is emitted at this boundary both outwards and inwards to conserve energy, and any wavelength that does not fit exactly within this size cannot be allowed for the inwards radiation, and therefore also for the outwards radiation. According to Hawking, the mass of a black hole is linearly related to its temperature or inversely-linearly related to the wavelength of the Hawking radiation it emits. Therefore, for a given size of the universe there is a maximum Hawking wavelength it can have and a minimum allowed gravitational mass it can have. If its mass was less than this then the Hawking radiation would have a wavelength that is bigger than the size of the observed universe and would be disallowed. The minimum mass it predicts is encouragingly close to the observed mass of the Hubble volume. Thus it is possible to model the Hubble volume as a black hole that emits Hawking radiation inwards, disallowing wavelengths that do not fit exactly into the Hubble diameter, since partial waves would allow an inference of what lies outside the horizon.
2. According to Tinaxi Zhang [13-15], the universe originated from a hot star-like black hole with several solar masses and gradually grew up through a super massive black hole with billion solar masses to the present state with hundred billion-trillion solar masses by accreting ambient materials and merging with other black holes. He says: our entire universe is one massive black hole, within which everything we "see" exists. Over time, as our universe evolves, the black holes that we observe will continue to grow and merge; eventually, all matter in our universe will merge together into one massive singularity. At this time, a new universe would be born within it. He continued his research in this direction and proposed many interesting concepts and relations that connect the observed CMBR radiation temperature and other astrophysical and cosmological observations.
3. According to N. J. Poplawski [16-19], the Universe is the interior of an Einstein-Rosen black hole and began with the formation of the black hole from a supernova explosion in the center of a galaxy. He theorizes that torsion manifests itself as a repulsive force which causes fermions to be spatially extended and prevents the formation of a gravitational singularity within the black hole's event horizon. Because of torsion, the collapsing matter on the other side of the horizon reaches an enormous but finite density, explodes and rebounds, forming an Einstein-Rosen bridge (wormhole) to a new, closed, expanding universe. Analogously, the Big Bang is replaced by the Big Bounce before which the Universe was the interior of a black hole. The rotation of a black hole would influence the space-time on the other side of its event horizon and results in a preferred direction in the new universe. Torsion in the ECSK gravity provides a theoretical explanation for a scenario, according to which every black hole produces a new, baby universe inside and becomes an Einstein-Rosen bridge (wormhole) that connects this universe to the parent universe in which the black hole exists. At extremely high densities, much larger than nuclear densities, torsion manifests itself as a force that counters gravitational attraction, preventing matter in a black hole from compressing to a singularity. Instead, matter reaches a state of finite, extremely high density, stops collapsing, undergoes a bounce, and starts rapidly expanding as a new universe. Extremely strong gravitational fields near the bounce cause an intense particle production, increasing the mass inside a black hole by many orders of magnitude. Accordingly, our own Universe could be the interior of a black hole existing in another universe.
4. Recently cosmologists Razieh Pourhasan, Niayesh Afshordi and Robert B. Manna have proposed [20] that the Universe formed from the debris ejected when a four-dimensional star collapsed into a black hole - a scenario that would help to explain why the cosmos seems to be so uniform in all directions.

From the above collected recent research information it is possible to say that the universe may have been borne inside a black hole, and the black holes in our own cosmos might be birthing new universes of their own. Based on the natural selection scheme (CNS), black holes may be representing the primordial responsible mechanism for the observed cosmic reproduction within a multi-verse[21,22]. With reference to the well believed big bang, in the universe there is no centre, there is no preferred direction and there is no rotation. With reference to galactic spinning black holes, it is well confirmed that, there is a center, there is rotation and there is a preferred direction. Considering a 4D/3D or 3D star like black hole (that is assumed to be responsible for the cosmic evolution) with no centre, with no preferred direction and with no rotation

is not correct. Hence the possible 'new solution' seems to be - to give up the old unanswerable concepts of big bang and to become accustomed with the newly accepted concepts of 4D/3D or 3D cosmic primordial black hole with center and rotation and see the consequences!

To have some clarity and to have some quantitative measurements and fittings of initial and current states of the black hole universe - instead of considering 'star - black hole explosions' and 'higher dimensions', the authors of this paper focused their attention only on the old and famous Mach's principle, 'Hubble volume' and 'primordial evolving black holes'. Some cosmologists use the term 'Hubble volume' to refer to the volume of the observable universe. There is no perfect theory that defines the lower and upper limits of a massive black hole. Most of the theoretical models assume a lower mass limit close to the 'Planck mass'. Astronomers believe that black holes that are as large as a billion solar masses can be found at the centre of most of the galaxies. Here the fundamental questions to be answered are: If the galactic central black hole mass is 10 billion solar masses and density is less than 1 kg/m^3 - with such a small density and large mass, without collapsing - how it is able to hold a gigantic galaxy? What force makes the black hole stable? Recent observations confirm that, instead of collapsing, galactic central black holes are growing faster and spinning with light speed. Even though mass is too high and density is too low, light speed rotation certainly helps in maintaining black hole's stability from collapsing with maximum possible outward radial force of the magnitude close to $\left(c^4/G\right)$. Based on these points the authors propose the following picture of Black hole cosmology. Forever rotating at light speed, high temperature and high angular velocity small sized primordial cosmic black hole of mass $M_C \cong \sqrt{e^2/4\pi\varepsilon_0 G}$ gradually transforms into a low temperature and low angular velocity large sized massive primordial cosmic black hole. At any given cosmic time, for the primordial growing black hole universe, its 'Schwarzschild radius' can be considered as its characteristic possible minimum radius and 'constant light speed rotation' will give the maximum possible stability from collapsing. Here $M_C \cong \sqrt{e^2/4\pi\varepsilon_0 G}$ can be called as the mass of the primordial baby black hole universe. Here 3 important points can be stated as follows.

1. In theoretical physics, particularly in discussions of gravitation theories, Mach's principle 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. 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, i) Each and every point in the free space is influenced by the Hubble mass, ii) Hubble volume and Hubble mass play a vital role in understanding the properties of electromagnetic and nuclear interactions and iii) Hubble volume and Hubble mass play a key role in understanding the geometry of the universe. With reference to the famous Mach's principle, 'Hubble volume' and 'Hubble mass' both can be considered as quantitative measurements of the 'distance cosmic back ground'. As a first attempt, in this paper authors proposed a semi empirical relation that connects the CMBR energy density, Hubble's constant and $\sqrt{e^2/4\pi\varepsilon_0 G}$.
2. Starting from an electron to any gigantic galaxy, rotation is a common phenomenon in atomic experiments and astronomical observations. From Newton's laws of motion and based on the Mach's principle, sitting inside a closed universe, one cannot comment whether the universe is rotating or not. We have to search for alternative means for confirming the cosmic rotation. Recent findings from the University of Michigan [27] 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. An anonymous referee who reviewed the paper for Physics Letters said, "In the paper the author claims that there is a preferred handedness of spiral galaxies indicating a preferred direction in the universe. Such a claim, if proven true, would have a profound impact on cosmology and would very likely result in a "Nobel prize". The consequences of a spinning universe [27-40] seem to be profound and natural. Not only that, with 'constant rotation speed' 'cosmic collapse' can be prevented and can be considered as an alternative to the famous 'repulsive gravity' concept. If so, at any time to have maximum possible stability from collapsing 'constant light speed rotation' can be considered as a constructive and workable concept.
3. Recent observations confirm black hole's light speed rotation. In 2013 February, using NASA's newly launched NuStar telescope and the European Space Agency's workhorse XMM-Newton, an international team observed high-energy X-rays released by a super massive black hole in the middle of a nearby galaxy. They calculated its spin at close to the speed of light: 670 million mph [41].Please note that, for any black hole even though its mass is too high and density is too low, light speed rotation certainly helps in maintaining its stability from collapsing with maximum possible outward radial force of magnitude $\left(c^4/G\right)$. At the beginning of comic evolution if rotation speed was zero and there was no big bang - definitely it will cast a doubt on the stability, existence and angular velocity of the assumed initial

primordial cosmic baby black hole. Hence at the beginning also, to guess or define the angular velocity and to have maximum possible stability it is better to assume light speed rotation for the cosmic baby black hole. At present if rate of cosmic expansion is very slow, then rate of decrease in angular velocity will be very small and practically can be considered as zero. Along with (practically) constant angular velocity, at present if constant light speed rotation is assumed to be maintained then cosmic stability will be maximum and rate of change in cosmic size will be practically zero and hence this idea helps us to believe in present Hubble length along with the observed ordered galactic structures and uniform thermal energy density.

4. The Cosmic 'Critical Density' and its Dimensional Analysis and the Cosmic Rotation

With a simple derivation it is possible to show that, Hubble's constant H_t represents the cosmological angular velocity. Authors presented this derivation in their published papers. Basic idea of this derivation is to express the angular velocity of any rotating celestial body in terms of its mass, radius, mass density and surface escape velocity. Assume that, a planet of mass M and radius 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,

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

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

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. Note that if Earth completes one rotation in one hour then free particles lying on the equator will get escape velocity. Now writing $M = \frac{4\pi}{3}R^3\rho_e$,

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

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

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 significance. 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 $\frac{3}{8\pi G}$,

$$\text{density} \propto \left(\text{angular velocity}\right)^2 \tag{5}$$

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.

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

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

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 depend on this "critical density" may consider 'angular velocity of the universe' in the place of 'Hubble's constant'. In the sense, with a great confidence '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. Thinking in this way, considering 'black hole geometry' as the 'eternal cosmic geometry' and by assuming 'constant light speed rotation' throughout the cosmic evolution, at any time the currently believed cosmic 'critical density' can be shown to be the cosmic black hole's eternal 'volume density'. Thus based on the Mach's principle, 'distance cosmic back ground' can be quantified in terms of 'Hubble volume' and 'Hubble mass'.

5. Re-Interpret the Hubble's Law

Hubble initially interpreted red shifts as a Doppler effect, due to the motion of the galaxies as they receded for our location in the Universe [23]. He called it a 'Doppler effect' as though the galaxies were moving 'through space'; that is how some astronomers initially perceived it. This is different to what has now become accepted but observations alone could not distinguish between the two concepts. In 1947 he [24] stated 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."

It may be noted that, increased redshifts and increased distances forced Edwin Hubble to propose the Hubble's law. Since galaxy is not a point particle and if light is coming from the atoms of the gigantic galaxy, then cosmic redshift can be interpreted as an index of the galactic atomic 'light emission mechanism'. In no way it seems to be connected with 'galaxy receding'. If it is possible to show that, (from the observer) observed older galaxy's distance increases with its 'age', then the concepts 'galaxy receding' and 'accelerating universe' can be put for a revision at fundamental level. Whatever may be the expression, definitions of cosmic red shift seem to be ad-hoc and not absolute. With reference to our laboratory or our galaxy, the basic or original definition of present/current redshift (z_0) can be expressed as follows.

$$z_0 \cong \frac{E_0 - E_G}{E_0} \cong \frac{\lambda_G - \lambda_0}{\lambda_G} \cong (z_x)_0 \le 1. \text{ (say)} \tag{9}$$

But not

$$z_0 \cong \frac{E_0 - E_G}{E_G} \cong \frac{\lambda_G - \lambda_0}{\lambda_0} \cong (z_y)_0 \text{ (say)} \tag{10}$$

Here $E_0 \cong \frac{hc}{\lambda_0}$ is the energy of photon at our galaxy/laboratory and $E_G \cong \frac{hc}{\lambda_G}$ is the energy of received photon when it was emitted in the galaxy. Similarly λ_G is the wave length of light received from distant galaxy when it was emitted and λ_0 is the wave length of light in laboratory.

With reference to the current definition of $z \cong (z_y)_0$, proposed $z \cong (z_x)_0$ can be expressed as follows.

$$(z_x)_0 \cong \frac{(z_y)_0}{1 + (z_y)_0} \tag{11}$$

Even though both relations are ad-hoc and not absolute definitions, compared to relation (10), relation (9) seems to be some- what reliable. Very interesting thing is that, when redshift is very small (up to $z \approx 0.01$), both relations almost all will

give the same result. Important point to be noticed is that, by Hubble's time the maximum redshift noticed was 0.003 and was less than 0.01. One should not ignore this fact. Now the fundamental question to be answered is: which relation is correct: either relation (9) or relation (10)? Note that, present red shift (z_0) will be directly proportional to age difference between our galaxy and observed galaxy or time taken by light to reach our galaxy from the observed galaxy (Δt). Thus $z_0 \propto \Delta t$ and

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

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,

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

$$c\Delta t \cong z_0 \cdot \frac{c}{H_0}. \tag{14}$$

To confirm this, absolute methods (that are free from redshift) for estimating galaxy age can be considered. Then 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. Hence with redshift concept - one may not be able to understand the actual rate of cosmic expansion and actual cosmic geometry [42].

6. Four Possible Assumptions

The possible assumptions in unified cosmic physics can be expressed in the following way.

Assumption-1: With reference to the elementary charge and with mass similar to the Planck mass, a new mass unit can be constructed in the following way. It can be called as the Coulomb mass.

$$\left(M_C\right)^{\pm} \cong \sqrt{\frac{e^2}{4\pi\varepsilon_0 G}} \cong 1.859272\times10^{-9}\ \text{Kg} \cong 1.042975\times10^{18}\ \text{GeV/c}^2 \tag{15}$$

It is well known that e, c, G play a vital role in fundamental physics. With these 3 constants space-time curvature concepts at a charged particle surface can be studied. Note that the basic concept of unification is to understand the origin of 'mass' of any particle. Mass is the basic property in 'gravitation' and charge is the basic property in 'atomicity'. So far no model established a cohesive relation in between 'electric charge' and 'mass' of any 'elementary particle' or 'cosmic dust'. From physics point of view, the fundamental questions to be answered are: 1) Without charge, is there any independent existence to "mass"? 2) Without mass, is there any independent existence to "charge"? From cosmology point of view the fundamental questions to be answered are: 1) What is 'cosmic dust'? 2) Without charge, is there any independent existence to "cosmic dust"? From astrophysics point of view the fundamental questions to be answered are: 1) Without charge, is there any independent existence to 'mass' of any star? 2) Is black hole – a neutral body or electrically a neutralized body? To understand these questions the authors made an attempt to construct the above unified mass unit. It is having a long history. It was first introduced by the physicist George Johnstone Stoney [43]. He is most famous for introducing the term 'electron' as the 'fundamental unit quantity of electricity'. With this mass unit in unification program with a suitable proportionality it may be possible to represent the characteristic mass of elementary charge. It can be considered as the seed of galactic matter or galactic central black hole. It can also be considered as the seed of any cosmic structure. If 2 such oppositely charged particles annihilates, a large amount of energy can be released. If so under certain extreme conditions at the vicinity of massive stars or black holes, a very high energy radiation can be seen to be emitted by the pair annihilation of M_C. With this mass unit, proton and electron rest masses and proton –electron mass ratio can be fitted in the following way.

$$\frac{\left(M_C m_e^2\right)^{\frac{1}{3}}}{m_p} \cong \ln\sqrt{\frac{m_p}{m_e}} \cdot \left(\frac{m_p}{m_e}\right) \tag{16}$$

Here, lhs=6908.3745 and rhs=6899.7363. Based on this fitting, obtained magnitude of the gravitational constant [44] is

$G \cong 6.7241367\times10^{-11}$ $m^3.kg^{-1}sec^{-2}$. Considering this coincidence it is possible to express the above relation in the following form.

$$\ln\sqrt{\frac{m_p}{m_e}}\cdot\left(\frac{m_p^2}{m_e}\right)\cong\left(M_C m_e^2\right)^{\frac{1}{3}} \tag{17}$$

By inserting the values of $\left(M_C \text{ and } m_e\right)$ in this relation with trial-error method proton rest mass and proton-electron mass ratio can be fitted simultaneously. This relation can be considered as an input for further study in charge-mass unification scheme. Another interesting observation is that $\ln\left[\frac{\left(M_C m_e^2\right)^{\frac{1}{3}}}{m_p}\right]\cong\ln(6900)\cong 8.84$ and is close to the presently believed inverse of the strong coupling constant $\left(1/\alpha_s\right)$ [44,45]. If so, $\alpha_s\cong\frac{1}{\ln(6900)}\cong 0.113$. With the following general mathematical series, $(\alpha_s)_{\exp}\cong\alpha_s+\frac{\alpha_s^2}{2}+\frac{\alpha_s^3}{3}+\frac{\alpha_s^4}{4}+\cdots$ experimental value of $\alpha_s\cong 0.120$ can be fitted accurately where its ground state theoretical value can be taken as 0.113.

Assumption-2: At any time Hubble length (c/H_t) can be considered as the gravitational or electromagnetic interaction range.

Assumption-3: At any time, H_t being the angular velocity, universe can be considered as a growing and light speed rotating primordial black hole. Thus at any given cosmic time,

$$R_t\cong\frac{2GM_t}{c^2}\cong\frac{c}{H_t}\ \text{ and }\ M_t\cong\frac{c^3}{2GH_t} \tag{18}$$

when $M_t\to M_C$, $R_C\cong\frac{2GM_C}{c^2}$ and $H_C\cong\frac{c}{R_C}\cong\frac{c^3}{2GM_C}$ can be considered as the characteristic initial physical measurements of the universe. Here the subscript C refers to the initial conditions of the universe and can be called as the Coulomb scale. Similarly $R_0\cong\frac{2GM_0}{c^2}\cong\frac{c}{H_0}$ and $M_0\cong\frac{c^3}{2GH_0}$ can be considered as the characteristic current physical measurements of the universe.

Assumption-4: Cosmic time is real and absolute.

7. Connecting Cosmic Thermal and Physical Parameters

It may be noted that connecting CMBR energy density with Hubble's constant is really a very big task and mostly preferred in cosmology. At any given cosmic time, thermal energy density can be expressed with the following semi empirical relation.

$$aT_t^4\cong\left[1+\ln\left(\frac{M_t}{M_C}\right)\right]^{-2}\left(\frac{3H_t^2c^2}{8\pi G}\right)\cong\left[1+\ln\left(\frac{H_C}{H_t}\right)\right]^{-2}\left(\frac{3H_t^2c^2}{8\pi G}\right) \tag{19}$$

With a suitable derivation if above expression is obtained, then certainly the subject of black hole cosmology is put into main stream physics. At any time

$$\frac{3H_t^2c^2}{8\pi GaT_t^4}\cong\left[1+\ln\left(\frac{M_t}{M_C}\right)\right]^2\cong\left[1+\ln\left(\frac{H_C}{H_t}\right)\right]^2 \tag{20}$$

Thus at present, if H_0 is close to 71 km/sec/Mpc, obtained CMBR temperature is 2.723 K. For the time being this can be considered as a remarkable discovery and an accurate fit.

$$aT_0^4 \cong \left[1+\ln\left(\frac{H_C}{H_t}\right)\right]^{-2}\left(\frac{3H_0^2c^2}{8\pi G}\right) \cong \left[1+\ln\left(\frac{M_0}{M_C}\right)\right]^{-2}\left(\frac{3H_0^2c^2}{8\pi G}\right) \tag{21}$$

Mostly at the ending stage of expansion, rate of change in H_t will be practically zero and can be considered as practically constant. Thus at its ending stage of expansion, for the whole cosmic black hole as H_t practically remains constant, its corresponding thermal energy density will be 'the same' throughout its volume. This 'sameness' may be the reason for the observed 'isotropic' nature of the current CMB radiation[45-48]. With this coincidence it can be suggested that, at the beginning of cosmic evolution,

$$aT_C^4 \cong \left(\frac{3H_C^2c^2}{8\pi G}\right) \tag{22}$$

Matter-energy density can be considered as the geometric mean density of volume energy density and the thermal energy density and it can be expressed with the following semi empirical relation.

$$(\rho_m)_t\, c^2 \cong \sqrt{\left(\frac{3H_t^2c^2}{8\pi G}\right)\left(aT_t^4\right)} \cong \left[1+\ln\left(\frac{H_C}{H_t}\right)\right]^{-1}\left(\frac{3H_t^2c^2}{8\pi G}\right) \cong \left[1+\ln\left(\frac{M_t}{M_C}\right)\right]^{-1}\left(\frac{3H_0^2c^2}{8\pi G}\right) \tag{23}$$

Here one important observation to be noted is that, at any time

$$\frac{3H_t^2}{8\pi G(\rho_m)_t} \cong \left[1+\ln\left(\frac{M_t}{M_C}\right)\right] \cong \left[1+\ln\left(\frac{H_C}{H_t}\right)\right] \tag{24}$$

Thus at present,

$$(\rho_m)_0 \cong \frac{1}{c^2}\sqrt{\left(\frac{3H_0^2c^2}{8\pi G}\right)\left(aT_0^4\right)} \cong \left[1+\ln\left(\frac{H_C}{H_0}\right)\right]^{-1}\left(\frac{3H_0^2}{8\pi G}\right) \cong \left[1+\ln\left(\frac{M_0}{M_C}\right)\right]^{-1}\left(\frac{3H_0^2}{8\pi G}\right) \tag{25}$$
$$\cong 6.6\times10^{-32}\,\text{gram}/\text{cm}^3$$

Based on the average mass-to-light ratio for any galaxy present matter density can be expressed with the following relation [49].

$$(\rho_m)_0 \cong 1.5\times10^{-32}\,\eta h_0 \ \ \text{gram/cm}^3 \tag{26}$$

Here $\eta \cong \left\langle\frac{M}{L}\right\rangle_{\text{galaxy}} \Big/ \left\langle\frac{M}{L}\right\rangle_{\text{sun}}$, $h_0 \cong H_0/100$ Km/sec/Mpc $\cong 0.71$ Note that elliptical galaxies probably comprise about 60% of the galaxies in the universe and spiral galaxies thought to make up about 20% percent 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 close to (6.0 to 6.7) $\times 10^{-32}$ gram/cm^3 and can be compared with the above proposed magnitude of 6.6×10^{-32} gram/cm^3.

8. Direct fitting of the current CMBR wave length

Note that the spectrum from Planck's law of black body radiation takes a different shape in the frequency domain from that of the wavelength domain, the frequency location of the peak emission does not correspond to the peak wavelength using the simple relationship between frequency, wavelength, and the speed of light. In other words, the peak wavelength and the peak frequency do not correspond. The frequency form of Wien's displacement law is derived using similar methods, but starting with Planck's law in terms of frequency instead of wavelength. The effective result is to substitute 3 for 5 in the equation for the peak wavelength. Thus it is possible to say that [50],

$$\sqrt{\frac{c}{\lambda_m f_m}} \cong \sqrt{1.75978} \cong 1.326567 \cong \frac{4}{3} \tag{27}$$

where λ_m and f_m are the peak wavelength in wavelength domain and peak frequency in frequency domain respectively. Let λ_f is the wavelength corresponding to $\frac{dE_\nu}{d\nu}$ and E_ν is the total energy at all frequencies up to and including ν, at any given cosmic time. λ_m is the wavelength corresponding to $\frac{dE_\lambda}{d\lambda}$ and E_λ is the total energy at all wavelengths up to and including λ. Considering the observed CMBR wavelengths, it is possible to express both the wavelengths in the following way.

$$\left[\left(\lambda_m\right)_t \text{ and } \left(\lambda_f\right)_t\right] \propto \sqrt{1+\ln\left(\frac{M_t}{M_C}\right)} \tag{28}$$

$$\left[\left(\lambda_m\right)_t \text{and } \left(\lambda_f\right)_t\right] \propto \sqrt{\left(\frac{4\pi G M_t}{c^2}\right)\cdot\left(\frac{4\pi G M_C}{c^2}\right)} \tag{29}$$

Guessing in this way it is noticed that,

$$\begin{aligned}\left(\lambda_f\right)_t &\cong \left(\frac{4}{3}\right)\cdot\sqrt{1+\ln\left(\frac{M_t}{M_C}\right)}\cdot\frac{4\pi G\sqrt{M_t M_C}}{c^2} \\ &\cong \left(\frac{4}{3}\right)\cdot\sqrt{\frac{3H_t^2}{8\pi G\left(\rho_m\right)_t}}\cdot\frac{4\pi G\sqrt{M_t M_C}}{c^2}\end{aligned} \tag{30}$$

$$\begin{aligned}\left(\lambda_m\right)_t &\cong \left(\frac{3}{4}\right)\cdot\sqrt{1+\ln\left(\frac{M_t}{M_C}\right)}\cdot\frac{4\pi G\sqrt{M_t M_C}}{c^2} \\ &\cong \left(\frac{3}{4}\right)\cdot\sqrt{\frac{3H_t^2}{8\pi G\left(\rho_m\right)_t}}\cdot\frac{4\pi G\sqrt{M_t M_C}}{c^2}\end{aligned} \tag{31}$$

Thus it is possible to express both the wavelength relations in the following way.

$$\begin{aligned}\left(\lambda_f,\lambda_m\right)_t &\cong \left(\frac{4}{3}\right)^{\pm 1}\cdot\sqrt{1+\ln\left(\frac{M_t}{M_C}\right)}\cdot\frac{4\pi G\sqrt{M_t M_C}}{c^2} \\ &\cong \left(\frac{4}{3}\right)^{\pm 1}\cdot\sqrt{1+\ln\left(\frac{H_C}{H_t}\right)}\cdot\frac{2\pi c}{\sqrt{H_C H_t}} \cong \left(\frac{4}{3}\right)^{\pm 1}\cdot\sqrt{\frac{3H_t^2}{8\pi G\left(\rho_m\right)_t}}\cdot\frac{2\pi c}{\sqrt{H_C H_t}}\end{aligned} \tag{32}$$

Alternatively geometric mean of $\left(\lambda_f,\lambda_m\right)_t$ can be expressed as follows.

$$\begin{aligned}\sqrt{\left(\lambda_m\right)_t\left(\lambda_f\right)_t} &\cong \sqrt{1+\ln\left(\frac{M_t}{M_C}\right)}\cdot\frac{4\pi G\sqrt{M_t M_C}}{c^2} \\ &\cong \sqrt{1+\ln\left(\frac{H_C}{H_t}\right)}\cdot\frac{2\pi c}{\sqrt{H_C H_t}} \cong \sqrt{\frac{3H_t^2}{8\pi G\left(\rho_m\right)_t}}\cdot\frac{2\pi c}{\sqrt{H_C H_t}}\end{aligned} \tag{33}$$

At present, if H_0 is close to 71 km/sec/Mpc,

$$\begin{aligned}\left(\lambda_f, \lambda_m\right)_0 &\cong \left(\frac{4}{3}\right)^{\pm 1} \cdot \sqrt{1+\ln\left(\frac{M_0}{M_C}\right)} \cdot \frac{4\pi G\sqrt{M_0 M_C}}{c^2} \\ &\cong \left(\frac{4}{3}\right)^{\pm 1} \cdot \sqrt{1+\ln\left(\frac{H_C}{H_0}\right)} \cdot \frac{2\pi c}{\sqrt{H_C H_t}} \cong \left(1.90 \text{ mm},\ 1.069 \text{ mm}\right)\end{aligned} \tag{34}$$

With reference to $\left(\lambda_m\right)_t$ and Wien's displacement constant, from relation (31) $k_B T_t$ can be expressed as follows.

$$\begin{aligned}T_t &\cong \frac{2.898\times 10^{-3}}{\left(\lambda_m\right)_t} \cong \left(\frac{hc}{4.965114 k_B}\right)\left(\frac{1}{\left(\lambda_m\right)_t}\right) \text{ and} \\ k_B T_t &\cong \left(\frac{4}{3x}\right)\sqrt{\left(1+\ln\left(\frac{M_t}{M_C}\right)\right)^{-1}\left(\frac{M_t}{M_C}\right)} \cdot \left(\frac{hc^3}{4\pi G M_t}\right)\end{aligned} \tag{35}$$

where $x \cong 4.965114$.

$$k_B T_t \propto \left(\frac{hc^3}{4\pi G M_t}\right) \cong \frac{hH_t}{2\pi} \tag{36}$$

This relation may not be identical but similar to the famous Hawking's black hole temperature formula [51].

$$k_B T_t \propto \sqrt{\left(1+\ln\left(\frac{M_t}{M_C}\right)\right)^{-1}\left(\frac{M_t}{M_C}\right)} \tag{37}$$

In this way in a very simple approach observed CMBR and the proposed Black hole universe concepts can be put into single frame of reference. Here the very interesting and strange observation is that, at present

$$\left(1+\ln\left(\frac{M_0}{M_C}\right)\right)^{-1}\left(\frac{M_0}{M_C}\right) \cong \exp\left(\frac{1}{\alpha}\right) \tag{38}$$

where $\left(\frac{1}{\alpha}\right)$ is the inverse of the fine structure ratio. For any mathematician this seems be a fun. For a cosmologist it may be an accidental coincidence. For any physicist it is an astounding and exciting coincidence. Even though it depends upon one's own choice of scientific interest, from unification point of view, assuming it to be a cosmological variable it is possible to express $\left(\frac{1}{\alpha}\right)$ in the following way.

$$\left(\frac{1}{\alpha}\right)_0 \cong \ln\left[\left(1+\ln\left(\frac{M_0}{M_C}\right)\right)^{-1}\left(\frac{M_0}{M_C}\right)\right] \cong 137.047 \tag{39}$$

Here $\left(\frac{1}{\alpha}\right)_0$ may be considered as the current magnitude of 'inverse of the fine structure ratio. Based on the above heuristic observation and for the assumed initial conditions of the universe , if $M_t \to M_C$, $\left(\frac{1}{\alpha}\right)_C \to 0$.

Now the fundamental questions to be answered are –

1) Is Fine structure ratio – a cosmological variable?

2) Is the reduced Planck's constant – a cosmological variable?

3) Is the Planck's constant – a cosmological constant?

4) How to understand and how to consider the constancy of the Planck's constant along with the variable reduced Planck's constant?

5) Is reduced Planck's constant – an output of the atomic system?

Based on the relation (38), if one is willing to consider the cosmological variable nature of $\left(\frac{1}{\alpha}\right)$, relation (35) can be expressed as follows.

$$T_t \cong \sqrt{\left(e^{\frac{1}{\alpha}}\right)_t} \cdot \left(\frac{bc^2}{3\pi G M_t}\right) \tag{40}$$

At the beginning of cosmic evolution,

$$T_C \cong \left(\frac{bc^2}{3\pi G M_C}\right) \tag{41}$$

From ground based laboratory experiments, it is possible to measure the rate of change in $\frac{d}{dt}\left(\frac{1}{\alpha_t}\right)$. Hence the absolute cosmic rate of expansion can be measured. Thus at any time based on $\left[\frac{d}{dt}(T_t) \text{ and } \frac{d}{dt}(H_t)\right]$, the absolute cosmic rate of expansion can be confirmed. At present with reference to $\left[\frac{d}{dt}(T_0) \text{ and } \frac{d}{dt}(H_0)\right]$ current 'true' cosmic rate of expansion can be understood. Fortunately as per the Cobe/Planck satellite data [45,46] current CMBR temperature is very smooth and isotropic. Hence it can be suggested that at present there is no significant cosmic expansion. Even though this suggesti -on is completely against to the current notion of cosmic acceleration [52,53], based on the proposed arguments, relations and observed data authors request the science community to review the standard cosmology. If observed CMB radiation temperature is 2.725 K and is very low in magnitude and is very close to absolute zero, then thinking about and confirming the 'cosmic acceleration' may not be reasonable.

In this direction it is also noticed that,

$$\frac{8\pi^5}{15}\left(\frac{bk_B}{hc}\right)^3 \cong \frac{4}{3} \quad \text{and} \quad a \cong \frac{4k_B}{3b^3} \tag{42}$$

From relations (22,41,42) the Boltzmann's constant and Wien's displacement constant can be interrelated with the elementary charge in the following way.

$$b \cong \frac{729\pi^3}{128}\left(\frac{e^2}{4\pi\varepsilon_0 k_B}\right) \cong 2.95084\times10^{-3} \text{ K.m} \tag{43}$$

Here accuracy [44] is close to 98.18%. Thus

$$h \cong \left[\left(\frac{2\pi^5}{5}\right)^{\frac{1}{3}}\left(\frac{729\pi^3}{128}\right)\right]\left(\frac{e^2}{4\pi\varepsilon_0 c}\right) \cong 6.7475333\times10^{-34} \text{ J.sec} \tag{44}$$

9. The Cosmic redshift and its new interpretation

Observed cosmic red shift can be reinterpreted as a cosmological galactic atomic light emission mechanism. If one is willing to consider this proposal, in hydrogen atom emitted photon energy can be understood as follows.

1. During cosmic evolution, as cosmic time increases, hydrogen atom emits photons with increased quanta of energy. Thus past light quanta emitted from old galaxy will have less energy and show a red shift with reference to our galaxy.
2. During journey light quanta will not lose energy and there will be no change in light wavelength.
3. Galactic photon energy when it was emitted can be estimated as follows.

$$E_t \cong \left(\frac{\lambda_0}{\lambda_G}\right)\left(\frac{hc}{\lambda_0}\right) \cong \frac{hc}{\lambda_G} \tag{45}$$

Here, λ_0 is the wavelength of photon in the laboratory.

E_t is the energy of received photon when it was emitted in the distant galaxy.

λ_G is the wavelength of received photon when it was emitted in the distant galaxy.

In the following section an attempt is made to understand the cosmological atomic light emission mechanism in hydrogen atom.

10. Cosmological discrete Bohr radii, discrete force, discrete potential and discrete nature of angular momentum in Hydrogen atom

Note that, in any bound system, 'operating force' only plays a major role in maintaining the 'existence of the bound system' and 'angular momentum' is one of the results. If one is able to make the operating force as discrete, then automatically one can observe a discrete structure like discrete radii, discrete angular momentum and discrete energy levels. The assumed cosmological characteristic discrete operating force can be expressed as follows.

$$\left(F_X\right)_n \cong \left(\frac{c^4}{nG}\right) \cong \frac{1}{n}\left(\frac{c^4}{G}\right) \qquad \text{Or} \tag{46}$$

$$\left(F_Y\right)_n \cong \left(\frac{c^4}{n^2G}\right) \cong \frac{1}{n^2}\left(\frac{c^4}{G}\right) \tag{47}$$

where $n = 1, 2, 3...$ Note that $\left(c^4 / G\right)$ can be considered as the limiting magnitude of any kind of force. Similarly $\left(c^5 / G\right)$ can be considered as the limiting magnitude of any kind of power [6,7]. Based on this proposal, the characteristic angular momentum can be shown to be proportional to n or $\sqrt{n}$. Vector sum of n and $\sqrt{n}$ can be expressed as follows

$$\sqrt{(n)^2 + \left(\sqrt{n}\right)^2} \cong \sqrt{n^2 + n} = \sqrt{n(n+1)}. \tag{48}$$

In a cosmological approach with various trial-error methods, at present in hydrogen atom, Bohr radius can be fitted as follows.

$$\left(a_B\right)_0 \cong \left(\frac{4\pi\varepsilon_0 G m_p^2}{e^2}\right)\left(\frac{GM_0}{c^2}\right) \cong \left(\frac{4\pi\varepsilon_0 M_0 c^2}{e^2}\right)\left(\frac{Gm_p}{c^2}\right)^2 \tag{49}$$

Note that, this relation is free from the famous reduced Planck's constant, electron rest mass and other arbitrary numbers or coefficients. With reference to the proposed discrete force and from above observation/fitting, current Bohr radii can be expressed as follows.

$$n^2\left(a_B\right)_0 \cong \left(\frac{4\pi\varepsilon_0 M_0 c^2}{e^2}\right)\left(Gm_p^2\right)\left(\frac{n^2 G}{c^4}\right) \tag{50}$$

In the past,

$$n^2\left(a_B\right)_t \cong \left(\frac{M_0}{M_t}\right)\left(\frac{4\pi\varepsilon_0 M_0 c^2}{e^2}\right)\left(Gm_p^2\right)\left(\frac{n^2 G}{c^4}\right) \tag{51}$$

$$\left(a_B\right)_t \propto \left(Gm_p^2\right) \tag{52}$$

$$\left(a_B\right)_t \propto \left(\frac{e^2}{4\pi\varepsilon_0 M_0 c^2}\right)^{-1} \tag{53}$$

$$\left(a_B\right)_t \propto \left(\frac{c^4}{n^2 G}\right)^{-1} \tag{54}$$

$$\left(a_B\right)_t \propto \left(\frac{M_0}{M_t}\right) \tag{55}$$

With reference to n^2 form, the current unified cosmological potential in hydrogen atom can be expressed as follows.

$$\begin{aligned}\left(E_{\text{pot}}\right)_0 &\cong -\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2}{4\pi\varepsilon_0 M_0 c^2}\right)\left(\frac{c^4}{n^2 G}\right) \\ &\cong -\frac{2}{n^2}\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2}{4\pi\varepsilon_0\left(c/H_0\right)}\right) \cong -\frac{1}{n^2}\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2 c^2}{4\pi\varepsilon_0 G M_0}\right)\end{aligned} \tag{56}$$

If revolving electron's kinetic energy is equal to half the magnitude of potential energy, then

$$\begin{aligned}\left(E_{\text{kin}}\right)_0 &\cong \frac{1}{2}\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2}{4\pi\varepsilon_0 M_0 c^2}\right)\left(\frac{c^4}{n^2 G}\right) \\ &\cong \frac{1}{n^2}\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2}{4\pi\varepsilon_0\left(c/H_0\right)}\right) \cong \frac{1}{\left(2n^2\right)}\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2 c^2}{4\pi\varepsilon_0 G M_0}\right)\end{aligned} \tag{57}$$

Here $2n^2$ can be considered as the total number of possible permitted electrons in any orbit. Total energy of one revolving electron out of $2n^2$ permitted possible electrons can be expressed as follows.

$$\begin{aligned}\left(E_{\text{total}}\right)_0 &\cong -\frac{1}{2}\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2}{4\pi\varepsilon_0 M_0 c^2}\right)\left(\frac{c^4}{n^2 G}\right) \\ &\cong -\frac{1}{n^2}\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2}{4\pi\varepsilon_0\left(c/H_0\right)}\right) \cong -\frac{1}{\left(2n^2\right)}\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2 c^2}{4\pi\varepsilon_0 G M_0}\right)\end{aligned} \tag{58}$$

At present in hydrogen atom, emitted photon energy can be expressed as follows.

$$\left(E_{\text{photon}}\right)_0 \cong \frac{1}{2}\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2}{4\pi\varepsilon_0 M_0 c^2}\right)\left[\left(\frac{c^4}{G}\right)\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)\right] \cong \frac{hc}{\lambda_0} \tag{59}$$

where $n_1 = n_2$ =1,2,3.,. and $n_2 > n_1$. With reference to the current time, at any time in the past,

$$\left(E_{\text{pot}}\right)_t \cong -\left(\frac{M_t}{M_0}\right)\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2}{4\pi\varepsilon_0 M_0 c^2}\right)\left(\frac{c^4}{n^2 G}\right) \tag{60}$$

$$\left(E_{\text{kin}}\right)_t \cong \frac{1}{2}\left(\frac{M_t}{M_0}\right)\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2}{4\pi\varepsilon_0 M_0 c^2}\right)\left(\frac{c^4}{n^2 G}\right) \tag{61}$$

$$\left(E_{\text{photon}}\right)_t \cong \frac{1}{2}\left(\frac{M_t}{M_0}\right)\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2}{4\pi\varepsilon_0 M_0 c^2}\right)\left[\left(\frac{c^4}{G}\right)\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)\right] \cong \frac{hc}{\lambda_G} \tag{62}$$

$$\left(E_{\text{pot}}\right)_t \propto \left(\frac{e^2}{4\pi\varepsilon_0 M_0 c^2}\right) \tag{63}$$

$$\left(E_{\text{pot}}\right)_t \propto \left(\frac{c^4}{n^2 G}\right) \tag{64}$$

$$\left(E_{\text{pot}}\right)_t \propto \left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right) \tag{65}$$

$$\left(E_{\text{pot}}\right)_t \propto \left(\frac{M_t}{M_0}\right) \tag{66}$$

In this way observed cosmic redshift can be understood and with reference to the observed λ_G of the distant galaxy, its corresponding H_t can be estimated as follows.

$$\frac{H_t}{H_0} \cong \left\{\frac{1}{2}\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2}{4\pi\varepsilon_0 M_0 c^2}\right)\left[\left(\frac{c^4}{G}\right)\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)\right]\right\}\left(\frac{hc}{\lambda_G}\right)^{-1} \tag{67}$$

$$\frac{M_t}{M_0} \cong \left(\frac{hc}{\lambda_G}\right)\left\{\frac{1}{2}\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2}{4\pi\varepsilon_0 M_0 c^2}\right)\left[\left(\frac{c^4}{G}\right)\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)\right]\right\}^{-1} \tag{68}$$

The current reduced Planck's constant can be fitted as follows.

$$\hbar_0 \cong \sqrt{\frac{M_0}{m_e}}.\frac{G m_p m_e}{c} \cong \frac{G m_p \sqrt{M_0 m_e}}{c} \tag{69}$$

Here $\frac{M_0}{m_e} \cong \frac{c^3}{2GH_0 m_e} \cong \frac{c}{H_0} \div \frac{2Gm_e}{c^2}$ can be considered as the virtual number of electrons in the current universe. Based on $\left(\frac{c^4}{n^2 G}\right)$, its discrete form can be expressed as follows.

$$n\hbar_0 \cong \sqrt{\frac{M_0}{m_e}}.\frac{n G m_p m_e}{c} \tag{70}$$

Based on $\left(\frac{c^4}{nG}\right)$,

$$\sqrt{n}\hbar_0 \cong \sqrt{\frac{M_0}{m_e}}.\frac{\sqrt{n} G m_p m_e}{c} \tag{71}$$

At any time in the past,

$$\hbar_t \cong \sqrt{\frac{m_e}{M_t}}.\frac{G m_p M_0}{c} \cong \sqrt{\frac{M_0}{M_t}}.\frac{G m_p \sqrt{M_0 m_e}}{c} \tag{72}$$

Thinking in this way at any time in the past, it is possible to express the assumed cosmological discrete force in the following form.

$$(F_X)_n \cong \left(\frac{M_t}{M_0}\right)\left(\frac{c^4}{nG}\right) \quad \text{Or} \tag{73}$$

$$(F_Y)_n \cong \left(\frac{M_t}{M_0}\right)\left(\frac{c^4}{n^2G}\right) \tag{74}$$

11. The Absolute Cosmic time

The concept of time has puzzled human beings for centuries. Many physicists have suggested that time is not actually real but a property that emerges from something more fundamental. In reality, the problem of determining the age of the universe is closely tied to the problem of determining the values of the cosmological parameters. Calculating the age of the universe is accurate only if the assumptions built into the models being used to estimate it are also accurate. In this regard for estimating the absolute magnitude of the cosmic time, the authors propose the following semi empirical relation.

$$t.H_t \cong \frac{3H_t^2c^2}{8\pi GaT_t^4} \cong \left[1+\ln\left(\frac{H_C}{H_t}\right)\right]^2 \tag{75}$$

$$aT_t^4 \cong \left(\frac{c/H_t}{ct}\right)\frac{3H_t^2c^2}{8\pi G} \cong \frac{3H_tc^2}{8\pi Gt} \tag{76}$$

where $t \geq 1/H_C$. It can be expressed in the following way also.

$$\left(aT_t^4\right)(t) \cong \frac{3H_tc^2}{8\pi G} \tag{77}$$

where $t \geq 1/H_C$. This can be considered as one very crucial and absolute application of the assumed cosmic age.

From above assumption or relation (20), current cosmic age can be obtained as follows.

$$t_0 \cong \left[1+\ln\left(\frac{H_C}{H_0}\right)\right]^2 \frac{1}{H_0} \cong 8.89\times10^{21} \text{ sec.} \tag{78}$$
$$\approx 282 \times 10^{12} \text{ years} \cong 282 \text{ trillion years.}$$

With this large time - smooth cosmic expansion, cosmic isotropy, super novae dimming and magnetic monopole vanishing etc can be understood. In Indian Vedic cosmology, total age of the universe is 311 trillion years [6,7,54]. This is a striking and surprising coincidence. It can be suggested that, modern cosmology and Indian Vedic cosmology can be studied in a unified manner. This obtained magnitude of current cosmic age plays a very interesting role in fitting the strength of electromagnetic interaction in the following way.

$$\left(e^{\frac{1}{\alpha}}\right)_t^{-2}\left(\frac{H_C}{H_t}\right)^2 \cong tH_t \cong \frac{3H_t^2c^2}{8\pi GaT_t^4} \tag{79}$$

12. To fit the nuclear charge radius and the Planck's constant

The subject of final unification is having a long history. After the nucleus was discovered [55] in 1908, it was clear that a new force was needed to overcome the electrostatic repulsion of the positively charged protons. Otherwise the nucleus could not exist. Moreover, the force had to be strong enough to squeeze the protons into a volume of size 10^{-15} meter. In general the word 'strong' is used since the strong interaction is the "strongest" of the four fundamental forces. Its observed strength is around 10^2 times that of the electromagnetic force, some 10^5 times as great as that of the weak force, and about 10^{39} times that of gravitation.

The aim of unification is to understand the relation that connects 'gravity', 'mass', 'charge' and the 'microscopic space-time curvature'. Many scientists addressed this problem in different ways [56-59]. The authors also made many attempts in their previously published papers. Experimentally observed nuclear charge radius R_{ch} can be fitted with the following strange and simple unified relation.

$$R_{ch} \cong \sqrt{\ln\left(\frac{e^2}{4\pi\varepsilon_0 G m_p m_e}\right)\cdot\left(\frac{e^2}{4\pi\varepsilon_0 G m_p m_e}\right)\cdot\left(\frac{2GM_C}{c^2}\right)} \cong 1.252 \text{ fermi} \tag{80}$$

Considering the rest energy of proton and 1.25 fermi, semi empirical mass formula energy coefficients can be fitted very easily.

$$\frac{R_{ch}c^2}{2GM_C} \cong \sqrt{\ln\left(\frac{e^2}{4\pi\varepsilon_0 G m_p m_e}\right)\cdot\left(\frac{e^2}{4\pi\varepsilon_0 G m_p m_e}\right)} \tag{81}$$

Whether the expression $\ln\left(\frac{e^2}{4\pi\varepsilon_0 G m_p m_e}\right) \cong 90.62$ playing a 'key unified role' or 'only a fitting role' to be confirmed.

With a great accuracy the famous Planck's constant can be fitted with the following relation.

$$\begin{aligned} h &\cong \frac{1}{2}\ln\left(\frac{e^2}{4\pi\varepsilon_0 G m_p m_e}\right)\cdot\left(\sqrt{m_p m_e}\cdot c\cdot R_{ch}\right) \\ &\cong \ln\sqrt{\frac{e^2}{4\pi\varepsilon_0 G m_p m_e}}\cdot\left(\sqrt{m_p m_e}\cdot c\cdot R_{ch}\right) \\ &\cong 6.63862\times10^{-34} \text{ J.sec} \end{aligned} \tag{82}$$

Recommended value of h is $6.6260695729\times10^{-34}$ J.sec and the error is 0.189%. From relation (80) above relation can be simplified into the following form [44].

$$h \cong \left[\ln\left(\frac{e^2}{4\pi\varepsilon_0 G m_p m_e}\right)\right]^{3/2}\left(\frac{e^2}{4\pi\varepsilon_0 c}\right) \tag{83}$$

Connecting quantum constants and gravity is really a very big task. At this juncture this relation can be a chance. It casts a doubt on the independent existence of quantum mechanics. With this relation, obtained magnitude of the gravitational constant is, $G \cong 7.48183566\times10^{-11}$ $m^3.kg^{-1}sec^{-2}$. Independent of 'length', 'force' and other physical considerations, with this relation order of magnitude of G can be confirmed from atomic physical constants. To proceed further - at first the hierarchy of physical constants must be established and it needs further study and analysis. The following section and the relations proposed therein may help in understanding the ground reality.

13 Role of Hubble potential in fitting the total energy of electron in hydrogen atom and to understand the discreteness of the reduced Planck's constant

After simplification and the considering the ground state, relations (56) to (58) can be expressed as follows.

$$\begin{aligned} \left(E_{\text{pot}}\right)_0 &\cong -\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2c^2}{4\pi\varepsilon_0 G M_0}\right) \cong -\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2}{4\pi\varepsilon_0}\right)\left(\frac{1}{2}\frac{c}{H_0}\right)^{-1} \\ &\cong -2\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2H_0}{4\pi\varepsilon_0 c}\right) \end{aligned} \tag{84}$$

Here $\left(\frac{e^2H_0}{4\pi\varepsilon_0 c}\right)$ can be called as the current Hubble potential and $\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)$ is the electromagnetic and gravitational force ratio of proton. This relation seems to be very simple and needs no further derivation. Factor 2 may be connected with half of the current Hubble length $\left(\frac{1}{2}\frac{c}{H_0}\right)$. For any physicist or cosmologist it will be a very big surprise. Characteristic ground state kinetic energy of electron can be expressed in the following way.

$$(E_{\text{kin}})_0 \cong \left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2c^2}{8\pi\varepsilon_0 GM_0}\right) \cong \left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2}{4\pi\varepsilon_0}\right)\left(\frac{c^2}{2GM_0}\right) \cong \left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2H_0}{4\pi\varepsilon_0 c}\right) \quad (85)$$

Characteristic ground state total energy of electron can be expressed in the following way.

$$(E_{\text{tot}})_0 \cong -\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2c^2}{8\pi\varepsilon_0 GM_0}\right) \cong -\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2}{4\pi\varepsilon_0}\right)\left(\frac{c^2}{2GM_0}\right) \cong -\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2H_0}{4\pi\varepsilon_0 c}\right) \cong \frac{e^4 m_e}{32\pi^2\varepsilon_0^2\hbar^2} \quad (86)$$

Unfortunately these relations seem to be independent of the reduced Planck's constant [60,61]. If one is willing to linkup these relations with the observed 'discrete' energy spectrum of the hydrogen atom, then the desired cosmological light emission mechanism can be developed in a unified picture. In terms of the present cosmic angular velocity,

$$\hbar \cong m_p\sqrt{\frac{Gm_e c}{2H_0}} \cong m_p\sqrt{(Gm_e)\left(\frac{GM_0}{c^2}\right)} \cong \frac{Gm_p\sqrt{m_e M_0}}{c} \quad (87)$$

If atomic nuclear mass increases in integral multiples of the proton mass, then the observed discreteness of the reduced Planck's constant can be expressed as follows.

$$n\hbar \cong (n.m_p)\sqrt{\frac{Gm_e c}{2H_0}} \cong \frac{G(n.m_p)\sqrt{m_e M_0}}{c} \quad (88)$$

where $n = 1, 2, 3, ..$ This issue is for further study. At any time in the past - in support of the proposed cosmological red shift interpretation, above relations can be re-expressed as follows.

$$(E_{\text{pot}})_t \cong -\left(\frac{H_0}{H_t}\right)\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2c^2}{4\pi\varepsilon_0 GM_0}\right) \cong -2\left(\frac{H_0}{H_t}\right)\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2H_0}{4\pi\varepsilon_0 c}\right) \quad (89)$$

$$(E_{\text{kin}})_t \cong \left(\frac{H_0}{H_t}\right)\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2H_0}{4\pi\varepsilon_0 c}\right) \quad (90)$$

$$(E_{\text{tot}})_t \cong -\left(\frac{H_0}{H_t}\right)\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2H_0}{4\pi\varepsilon_0 c}\right) \quad (91)$$

14. To understand the physical significance of large numbers in cosmology

Great cosmologists proposed many interesting large numbers in cosmology [62-69]. Ultimately the essence of any cosmological number or ratio is to connect the microscopic and macroscopic physical constants with a possible physical meaning with in the 'evolving universe'. Clearly speaking large dimensionless constants and compound physical constants must reflect an 'observable' intrinsic property of any natural physical phenomenon. Then only the real meaning of any cosmological number can be explored. In this regard authors proposed many interesting relations in the previous sections of this paper. Authors noticed that uncertainty relation or Planck's constant or reduced Planck's constant or inverse of the Fine structure ratio or characteristic nuclear potential radius or rms radius of proton or classical radius of electron - play a crucial role in the understanding the halt of cosmic expansion. The basic questions to be answered are: 1) The general idea of large number coincidence is interesting, yet is there any observational proves? and 2) How Einstein's general theory of

relativity is fitted in the theory of the large cosmological numbers ? In this regard the characteristic and key relation can be expressed in the following way.

$$\frac{c^3}{2GM_0} \cong H_0 \quad \text{Or} \quad \frac{c^3}{2GH_0} \cong M_0 \tag{92}$$

Here (M_0, H_0) can be considered as the current mass and current angular velocity of the black hole universe respectively. By this time if the expanding black hole universe is coming to a halt, then above relation can be re-expressed as follows.

$$\frac{c^3}{2GM_S} \cong H_S \quad \text{Or} \quad \frac{c^3}{2GH_S} \cong M_S \tag{93}$$

Here (M_S, H_S) can be considered as the saturated mass and saturated angular velocity of the black hole universe at its ending stage of expansion. Fortunately it is noticed that, $M_S \cong M_0$ and $H_S \cong H_0$. Authors strongly believe that the following relations certainly help in understanding the mystery of the halting of the present cosmic expansion.

14.1 Role of the Uncertainty relation

It is noticed that,

$$\frac{Gm_p m_e}{R_p H_0} \cong \frac{h}{4\pi} \tag{94}$$

Here $R_p \cong (0.84184 \text{ to } 0.87680)$ fm is the rms radius of proton [44,70]. After re-arranging, it can be expressed in the following way.

$$\left(\frac{2Gm_p}{c^2 R_p}\right)\frac{m_e c^2}{H_0} \cong \left(\frac{2Gm_p}{c^2 R_p}\right)\left[m_e c\left(\frac{c}{H_0}\right)\right] \cong \hbar \tag{95}$$

$$\left(\frac{2Gm_p}{c^2 R_p}\right)\frac{c}{H_0} \cong \frac{\hbar}{m_e c} \tag{96}$$

By this time if the expanding black hole universe is coming to a halt, then above relation can be re-expressed as follows.

$$H_S \Rightarrow \frac{4\pi G m_p m_e}{h R_p} \cong \frac{G m_p m_e}{(h/4\pi) R_p} \Rightarrow (67.87 \text{ to } 70.69) \text{ km/sec/Mpc} \tag{97}$$

This is a remarkable fit and needs further study.

14.2 Role of the reduced Planck's constant

From relation (87) it is noticed that,

$$\sqrt{\frac{M_0}{m_e}}\left(\frac{Gm_p m_e}{c}\right) \cong \hbar \tag{98}$$

Here $\hbar$ is the characteristic quantum of angular momentum [59,60]. $\left(\frac{M_0}{m_e}\right)$ can be considered as the virtual number of

electrons in the current Hubble mass (M_0). By this time if the black hole universe is coming to a halt, then above relation can be re-expressed as follows.

$$H_S \Rightarrow \frac{Gm_p^2 m_e c}{2\hbar^2} \cong 70.738 \text{ km/sec/Mpc} \tag{99}$$

This is also a remarkable fit and needs further study. Another interesting form can be expressed as follows.

$$\frac{G\sqrt{M_0 m_e}}{c^2} \cong \frac{\hbar}{m_p c} \tag{100}$$

By this time if the expanding black hole universe is coming to a halt, then

$$\frac{G\sqrt{M_S m_e}}{c^2} \Rightarrow \frac{\hbar}{m_p c} \tag{101}$$

14.3 Role of the classical radius of electron

It is noticed that,

$$\sqrt{\left(\frac{2G\sqrt{m_p m_e}}{c^2}\right)\left(\frac{c}{H_0}\right)} \cong \sqrt{\left(\frac{2G\sqrt{m_p m_e}}{c^2}\right)\left(\frac{2GM_0}{c^2}\right)} \cong \left(\frac{e^2}{4\pi\varepsilon_0 m_e c^2}\right) \tag{102}$$

$\left(\frac{e^2}{4\pi\varepsilon_0 m_e c^2}\right)$ is nothing but the presently believed classical radius of electron. In a broad picture or considering the interaction in between proton and electron it is a very general idea to consider the geometric mean mass of proton and electron. By this time if the expanding black hole universe is coming to a halt, then above relation can be re-expressed as follows.

$$\left(\frac{c}{H_S}\right) \Rightarrow \left(\frac{e^2}{4\pi\varepsilon_0 m_e c^2}\right)^2 \left(\frac{c^2}{2G\sqrt{m_p m_e}}\right) \tag{103}$$

$$H_S \Rightarrow \frac{2G\sqrt{m_p m_e}}{c}\left(\frac{4\pi\varepsilon_0 m_e c^2}{e^2}\right)^2 \cong 67.533 \text{ km/sec/Mpc} \tag{104}$$

This is also a remarkable fit and needs further study.

14.4 Role of the characteristic nuclear potential radius

It is noticed that,

$$\frac{G\sqrt{M_0\sqrt{m_p m_e}}}{c^2} \cong 1.4\times10^{-15} \text{ m} \cong \text{R}_n \tag{105}$$

R_n is nothing but the presently believed characteristic nuclear potential radius [55] or the nuclear strong interaction range as proposed by Yukawa [71]. By this time if the expanding black hole universe is coming to a halt, then above relation can be re-expressed as follows.

$$\frac{G\sqrt{M_S\sqrt{m_p m_e}}}{c^2} \Rightarrow R_n \tag{106}$$

$$H_S \Rightarrow \frac{G\sqrt{m_p m_e}}{2cR_n^2} \tag{107}$$

This is also a remarkable coincidence and accuracy mainly depends upon the magnitude of the characteristic nuclear potential radius. Further study may reveal the mystery.

14.5 Role of the 'inverse' of the Fine structure ratio

Total thermal energy in the present Hubble volume can be expressed as follows.

$$(E_T)_0 \cong aT_0^4 \cdot \frac{4\pi}{3}\left(\frac{c}{H_0}\right)^3 \tag{108}$$

Thermal energy present in half of the current Hubble volume can be expressed as follows.

$$\frac{(E_T)_0}{2} \cong \frac{1}{2}\left[aT_0^4 \cdot \frac{4\pi}{3}\left(\frac{c}{H_0}\right)^3\right] \tag{109}$$

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

$$(E_e)_0 \cong \frac{e^2}{4\pi\varepsilon_0 (c/H_0)} \cong \frac{e^2 H_0}{4\pi\varepsilon_0 c} \tag{110}$$

If H_0 is close to 71 km/sec/Mpc and $T_0 \cong 2.725$ K, it is noticed that,

$$\ln\sqrt{\frac{\lfloor (E_T)_0/2 \rfloor}{(E_e)_0}} \cong 137.05 \tag{111}$$

In atomic and nuclear physics, the fine-structure ratio (α) is a fundamental physical constant namely the coupling constant characterizing the strength [44,72] of the electromagnetic interaction. Being a dimensionless quantity, it has a constant numerical value in all systems of units. 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 or coincidence can be considered as a key tool in particle cosmology. By this time if the expanding black hole universe is coming to a halt, then above relation can be re-expressed as follows.

$$\ln\sqrt{\frac{\lfloor (E_T)_0/2 \rfloor}{(E_e)_0}} \cong \ln\sqrt{\frac{\lfloor (E_T)_S/2 \rfloor}{(E_e)_S}} \Rightarrow \left(\frac{1}{\alpha}\right) \tag{112}$$

$(E_T)_S$ can be considered as the total thermal energy in the Hubble volume at the end of cosmic expansion.

$(E_e)_S$ can be considered as the Hubble potential at the end of cosmic expansion.

15. Conclusions

15.1 Need of the mass unit $M_C \cong \sqrt{e^2/4\pi\varepsilon_0 G}$ in unification

The basic idea of unification is – 1) To minimize the number of physical constants and to merge a group of different fundamental constants into one compound physical constant with appropriate unified interpretation and 2) To merge and minimize various branches of physics. 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, experiments and analysis. The first step in unification is to understand the origin of the rest mass of a charged elementary particle. Second step is to understand the combined effects of its electromagnetic (or charged) and gravitational interactions. Third step is to understand its behavior with surroundings when it is created. Fourth step is to understand its behavior with cosmic space-time or other particles. Right from its birth to death, in all these steps the underlying fact is that whether it is a strongly interacting particle or weakly interacting particle, it is having some rest mass. To understand the first two steps somehow one can implement the gravitational constant in sub atomic physics. In this regard $M_C \cong \sqrt{e^2/4\pi\varepsilon_0 G}$ can be considered as the nature's given true unified mass unit [43]. From relations (16) and (17), magnitude of the gravitational constant can be fitted with the following relation [44].

$$\left.\begin{aligned} &\text{If } X \cong \ln\sqrt{\frac{m_p}{m_e}}\cdot\left(\frac{m_p}{m_e}\right) \text{ and } M_C \cong X^3\left(\frac{m_p^3}{m_e^2}\right) \\ &G \cong \frac{e^2}{4\pi\varepsilon_0 M_C^2} \cong 6.7241367\times10^{-11}\ \text{m}^3.\text{kg}^{-1}\text{sec}^{-2} \end{aligned}\right\} \qquad (113)$$

where $m_p \cong 1.672621637\times10^{-27}$ kg, $m_e \cong 9.109382154\times10^{-31}$ kg and $e \cong 1.602176487\times10^{-19}$ coulombs.

Please note that, the accuracy of the measured value of G has increased only modestly since the original Cavendish experiment. G is quite difficult to measure, as gravity is much weaker than other fundamental forces, and an experimental apparatus cannot be separated from the gravitational influence of other bodies. Furthermore, gravity has no established relation to other fundamental forces, so it does not appear possible to calculate it indirectly from other constants that can be measured more accurately, as is done in some other areas of physics. Published values of G have varied rather broadly, and some recent measurements of high precision are, in fact, mutually exclusive [73]. Its 2013 experimental magnitude is [74] $6.67545(18)\times10^{-11}$ $\text{m}^3.\text{kg}^{-1}\text{sec}^{-2}$. Its 2007 experimental value [75] is $(6.693\pm0.027)\times10^{-11}$ $\text{m}^3.\text{kg}^{-1}\text{sec}^{-2}$. Its current recommended [44] value is $6.67384(80)\times10^{-11}$ $\text{m}^3.\text{kg}^{-1}\text{sec}^{-2}$. In this regard, from unification point of view relation (113) can be given some consideration.

15.2 Need of semi empirical approach

Even though 'dark energy' holds 70% of the unseen matter content of the universe, its role in understanding the basic concepts of unification is very insignificant. Even though Super Symmetry is having excellent theoretical support and in-depth mathematical back ground, based on SUSY concepts so far no single SUSY boson could be detected in the Large Hadron Collider. This puzzling issue casts doubt on the continued existence of SUSY. In a nutshell, it is very clear that something is missing from our 'unification' knowledge net! Missing knowledge can be obtained only through intellectual thinking, mathematical modeling, probing the atomic nucleus and universe to the possible extent, constructing semi empirical relations among physical constants of various interdisciplinary branches of physics with all possible interpretations and so on. Which way/method is the best - will be decided by future experiments, observations and interpretations. As it is interconnected with all branches of physics, 'semi empirical approach' seems be the easiest and shortcut way. It sharpens and guides human thinking ability in understanding the reality of unification. For any theoretical concept or mathematical model or semi empirical relation, 'workability' is more important than its inner beauty and 'workability' is the base of any semi empirical approach.

15.3 Need of black hole cosmology and dark matter

Authors are working on the assumed Hubble volume and Hubble mass in different directions with different applications [76-81] that connect micro physics and macro physics. Based on the proposed applications – parallel to the standard model of cosmology - concepts of black hole cosmology may be given at least 50% probability instead of 1%. Authors repeat the statement that - compared to the Big bang model, advantage of Black hole cosmology lies in confirming its validity through the ground based atomic and nuclear experimental results. By considering the zero rate of change in inverse of the Fine structure ratio (from the ground based laboratory experimental results), with reference to the zero rate of change in the current CMBR temperature (from satellite data) and zero rate of change in the 'current Hubble's constant' it can be suggested that, current cosmic expansion is almost all saturated and at present there is no significant cosmic expansion and there is no significant cosmic acceleration. It can be also be possible to suggest that currently believed 'dark energy' is a pure 'mathematical concept' and there exists no physical base behind its confirmation. Even though existence of 'dark energy' is ad-hoc, from particle physics point of view 'dark matter' seems to be very interesting. Leaving the 'dark energy' concept, from now onwards one can concentrate in exploring and understanding the mystery of the existence of dark matter [82-88]. Now the key leftover things are nucleosynthesis and structure formation. Authors are working in this direction. As nuclear binding energy was zero at the beginning of cosmic evolution, by considering the time dependent variable nature of magnitudes of the semi empirical mass formula energy coefficients it is possible to show that, at the beginning of formation of nucleons, nuclear stability is maximum for light atoms only. If so it can be suggested that, from the beginning of formation of nucleons, in any galaxy, maximum scope is being possible only for the survival of light atoms and this may be the reason for the accumulation and abundance of light atoms in large proportion.

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