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Friedman cosmology: reconsideration and new results

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Abstract

Throughout the cosmic evolution, currently believed cosmic 'critical density' can be shown to be a default result of the 'positively curved' light speed rotating black hole universe. As there is no observational or experimental evidence to Friedmann's second assumption, the density classification scheme of Friedmann cosmology must be reviewed at fundamental level and possibly can be relinquished. The observed cosmic redshift can be reinterpreted as an index of 'cosmological' light emission mechanism. Clearly speaking, 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. Note that in 1947 Edwin Hubble himself thought for a new mechanism for understanding the observed galactic redshift data. By considering the 'Planck mass' 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. Uncertainty relation and all other microscopic physical constants play a crucial role in understanding the halt of the present cosmic expansion.

Keywords

Friedmann Cosmology, Black Hole Cosmology, Hubble Potential, Halting of Cosmic Expansion, Final Unification

1. Introduction

In this paper by reviewing the major short comings of Friedmann cosmology [1] an attempt is made to develop a possible model of black hole cosmology. Friedmann made two simple assumptions about the universe. They can be stated in the following way.

1. When viewed at large enough scales, universe appears the same in every direction.
2. When viewed at large enough scales, universe appears the same from every location.

In this regard Hawking says [2]: "There is no scientific evidence for the Friedmann's second assumption. We believe it only on grounds of modesty: it would be most remarkable if the universe looked the same in every direction around us, but not around other points in the universe". This is one key point to be noted here. The term 'critical density' is the back bone of modern cosmology. At any time in the past, it is generally expressed in the following way.

$$(\rho_c)_t \cong \frac{3H_t^2}{8\pi G} \tag{1}$$

Its current expression is as follows.

$$(\rho_c)_0 \cong \frac{3H_0^2}{8\pi G} \tag{2}$$

According to standard Friedmann cosmology,

1. If matter density is greater than the critical density, universe will have a positive curvature.
2. If matter density equals the critical density, universe will be flat.
3. If matter density is less than the critical density, universe will have a negative curvature.

But by 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'. If mass of the black hole universe is M_t, $\left(\frac{c}{H_t}\right)$ is the radius of the black hole universe that rotates at light speed and angular velocity H_t, at any time in the past,

$$\begin{aligned}(\rho_v)_t &\cong (M_t)\left[\frac{4\pi}{3}\left(\frac{c}{H_t}\right)^3\right]^{-1} \\ &\cong \left(\frac{c^3}{2GH_t}\right)\left[\frac{3}{4\pi}\left(\frac{H_t}{c}\right)^3\right] \cong \frac{3H_t^2}{8\pi G}\end{aligned} \quad (3)$$

where $\frac{2GM_t}{c^2} \cong \frac{c}{H_t}$ and $M_t \cong \frac{c^3}{2GH_t}$.

At present,

$$\begin{aligned}(\rho_v)_0 &\cong (M_0)\left[\frac{4\pi}{3}\left(\frac{c}{H_0}\right)^3\right]^{-1} \\ &\cong \left(\frac{c^3}{2GH_0}\right)\left[\frac{3}{4\pi}\left(\frac{H_0}{c}\right)^3\right] \cong \frac{3H_0^2}{8\pi G}\end{aligned} \quad (4)$$

Based on this coincidence and as there is no observational or experimental evidence to Friedmann's second assumption, the density classification scheme of Friedmann cosmology must be reviewed at fundamental level. In this regard in the following section an attempt is made to highlight the major shortcomings of standard cosmology.

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 [3,4]. 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 analyzing the past data, one cannot 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) 'Rate of decrease in current 'Hubble's constant' can be considered as a measure of current cosmic 'rate of expansion'. If rate of decrease in current 'Hubble's constant is very small and is beyond the scope of current experimental verification, then the two possible states are: a) current 'Hubble's constant is decreasing at a very slow rate and current universe is expanding at a very slow rate and b) at present there is no 'observable' cosmic expansion. 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'. At present if universe is accelerating, current time should run fast.
5) The standard Big Bang model tells us that the Universe exploded out of an infinitely dense point, or singularity. 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 GTR 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 are 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 [1].
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-4.
12) Even though it was having strong footing, Mach's principle [5] 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 authors 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.
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 'current cosmic temperature' can be considered as a measure of current cosmic expansion and 'rate of decrease in current cosmic temperature' can be considered as a measure of cosmic 'current rate of expansion'. But if rate of decrease in current temperature is very small and is beyond the scope of current experimental verification, then the two possible states are: a) current cosmic temperature is decreasing at a very slow rate and current universe is expanding at a very slow rate and b) at present there is no 'observable' thermal expansion and there is no 'observable' cosmic expansion.
19) If observed CMBR 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. 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. Possible Assumptions and Explanation

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

Assumption-1: Planck mass $M_{Pl} \cong \sqrt{hc/2\pi G}$ can be considered as the characteristic initial mass of the baby cosmic black hole. Planck mass can be derived with the following three conditions.

$$\left.\begin{array}{l} M_{Pl}c^2 \equiv \dfrac{hc}{\lambda_{Pl}} \text{ and } M_{Pl} \equiv \dfrac{h}{c\lambda_{Pl}} \\ \dfrac{GM_{Pl}M_{Pl}}{r_{Pl}^2} \equiv \dfrac{GM_{Pl}^2}{r_{Pl}^2} \equiv k\dfrac{c^4}{G} \text{ and} \\ 2\pi r_{Pl} \equiv \lambda_{Pl} \end{array}\right\} \quad (5)$$

where λ_{Pl} is the Planck wave length, r_{Pl} can be considered as a characteristic distance related with Planck wavelength λ_{Pl} and k is a proportionality coefficient equal to 1. $\left(\dfrac{c^4}{G}\right)$ can be considered as the upper limit of any kind of force and it can also be considered as the energy extraction constant of any black hole.

Assumption-2: At any time Hubble length $\left(c/H_t\right)$ 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.

Assumption-4: Cosmic red shift can be considered as a result of new cosmological light emission mechanism (Please see section-7).

Thus at any given cosmic time,

$$R_t \cong \frac{2GM_t}{c^2} \cong \frac{c}{H_t} \text{ and } M_t \cong \frac{c^3}{2GH_t} \quad (6)$$

when $M_t \to M_{Pl}$,

$$R_{Pl} \cong \frac{2GM_{Pl}}{c^2} \text{ and } H_{Pl} \cong \frac{c}{R_{Pl}} \cong \frac{c^3}{2GM_{Pl}} \quad (7)$$

can be considered as the characteristic initial physical measurements of the universe. Here the subscript Pl refers to the initial conditions of the universe and can be called as the Planck scale. Similarly

$$R_0 \cong \frac{2GM_0}{c^2} \cong \frac{c}{H_0} \text{ and } \mathrm{M}_0 \cong \frac{c^3}{2GH_0} \quad (8)$$

can be considered as the characteristic current physical measurements of the universe.

3.1. Explanation for the Proposed Assumptions

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'. 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 $M_{Pl} \cong \sqrt{hc/2\pi G}$ 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 $M_{Pl} \cong \sqrt{hc/2\pi G}$ 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 $M_{Pl} \cong \sqrt{hc/2\pi G}$.
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 suggest that the shape of the Big Bang might be more complicated than previously thought, and that the early universe spun on an axis[8]. 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. The consequences of a spinning universe 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 [9].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,

$$\frac{1}{2}mv_e^2 = \frac{GMm}{R} \tag{9}$$

$$R\omega_e = v_e = \sqrt{\frac{2GM}{R}} \text{ and } \omega_e = \frac{v_e}{R} = \sqrt{\frac{2GM}{R^3}} \tag{10}$$

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

$$\omega_e = \frac{v_e}{R} = \sqrt{\frac{8\pi G\rho_e}{3}} \text{ Or } \omega_e^2 = \frac{8\pi G\rho_e}{3} \tag{11}$$

$$\text{Density, } \rho_e = \frac{3\omega_e^2}{8\pi G} \tag{12}$$

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

$$\text{density} \propto (\text{angular velocity})^2 \tag{13}$$

Equation (12) is similar to "flat model concept" of cosmic "critical density"

$$\rho_c = \frac{3H_t^2}{8\pi G} \tag{14}$$

Comparing equations (12) and (14) dimensionally and conc eptually, i.e.

$$\rho_e = \frac{3\omega_e^2}{8\pi G} \text{ with } \rho_c = \frac{3H_t^2}{8\pi G} \tag{15}$$

$$H_t^2 \to \omega_e^2 \text{ and } H_t \to \omega_e \tag{16}$$

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.

5. Role of Hawking's Black Hole Temperature Formula in Connecting the Current CMBR Temperature and the Current Hubble's Constant

It may be noted that connecting CMBR energy density with Hubble's constant is really a very big task and mostly preferred in model of cosmology. Based on the proposed concepts and based on the famous Hawking's black hole temperature formula [5] it is possible to fit and correlate the current CMBR temperature and current Hubble's constant in the following way [6,7].

$$T_0 \cong \frac{\hbar c^3}{8\pi G k_B \sqrt{M_0 \cdot M_{Pl}}} \cong \sqrt{\left(\frac{\hbar c^3}{8\pi G k_B M_0}\right)\left(\frac{\hbar c^3}{8\pi G k_B M_{Pl}}\right)} \tag{17}$$

In terms of angular velocity of the cosmic black hole above relation can be expressed in the following way.

$$T_0 \cong \frac{\hbar}{4\pi k_B}\sqrt{\left(\frac{c^3}{2GM_0}\right)\left(\frac{c^3}{2GM_{Pl}}\right)} \cong \frac{\hbar}{4\pi k_B}\sqrt{H_0 \cdot H_{Pl}} \tag{18}$$

From Planck satellite data [10] current CMBR temperature is $(2.72548 \pm 00057)\ ^0\text{K}$ and current Hubble constant is (67.80 ± 0.77) km/sec/Mpc. From above relation current Hubble's constant can be expressed and fitted in the following way.

$$H_0 \cong \left(\frac{4\pi k_B T_0}{\hbar}\right)^2 \frac{1}{H_{Pl}} \cong \left(\frac{4\pi k_B T_0}{\hbar}\right)^2 \left(\frac{2GM_{Pl}}{c^3}\right)$$
$$\cong 2.167829844 \times 10^{-18} \text{ rad/sec} \cong 66.8927255 \text{ km/sec/Mpc.} \tag{19}$$

This is an excellent fit and can be considered as a characteristic relation in black hole cosmology. Based on this coincidence, at any time in the past,

$$T_t \cong \frac{\hbar}{4\pi k_B}\sqrt{\left(\frac{c^3}{2GM_t}\right)\left(\frac{c^3}{2GM_{Pl}}\right)} \cong \frac{\hbar}{4\pi k_B}\sqrt{H_t \cdot H_{Pl}} \tag{20}$$

$$H_t \cong \left(\frac{4\pi k_B T_t}{\hbar}\right)^2 \frac{1}{H_{Pl}} \cong \left(\frac{4\pi k_B T_t}{\hbar}\right)^2 \left(\frac{2GM_{Pl}}{c^3}\right) \tag{21}$$

In terms of the Uncertainty relation above relations (17) and (19) can be rearranged in the following way. At present

$$k_BT_0 \cong \frac{(h/4\pi)c^3}{4\pi G\sqrt{M_0 \cdot M_{Pl}}} \cong \left(\frac{h}{4\pi}\right)\sqrt{\left(\frac{c^3}{4\pi GM_0}\right)\left(\frac{c^3}{4\pi GM_{Pl}}\right)} \cong \left(\frac{h}{4\pi}\right)\sqrt{\left(\frac{H_0}{2\pi}\right)\left(\frac{H_{Pl}}{2\pi}\right)} \quad (22)$$

At any time in the past,

$$k_BT_t \cong \frac{(h/4\pi)c^3}{4\pi G\sqrt{M_t \cdot M_{Pl}}} \cong \left(\frac{h}{4\pi}\right)\sqrt{\left(\frac{c^3}{4\pi GM_t}\right)\left(\frac{c^3}{4\pi GM_{Pl}}\right)} \cong \left(\frac{h}{4\pi}\right)\sqrt{\left(\frac{H_t}{2\pi}\right)\left(\frac{H_{Pl}}{2\pi}\right)} \quad (23)$$

$$\left(\frac{2\pi_t}{\sqrt{H_tH_{Pl}}}\right)k_BT \cong \frac{h}{4\pi} \quad (24)$$

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 current CMBR temperature is very smooth and isotropic. Hence it can be suggested that at present there is no cosmic expansion and there is no cosmic acceleration [11]. Please note that if observed CMBR 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. It is true that this suggestion is completely against to the current notion of standard cosmology. But in any way relation (17) cannot be ignored. Cosmologists, astrophysicists and physicists well believe in the Planck scale and its role in unification. Note that relation (17) makes a very simple and very nice attempt in connecting Cosmology, Black hole physics and Quantum mechanics in a very simple approach. Mostly at the ending stage of expansion, rate of change in H_0 will be practically zero and can be considered as practically constant. Thus at its ending stage of cosmic expansion, for the whole cosmic black hole as H_0 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.

6. Relation between Cosmic Thermal Energy Density and Matter Density

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.

$$(\rho_m)_t \cong \frac{1}{c^2}\sqrt{\left(\frac{3H_t^2c^2}{8\pi G}\right)\left(aT_t^4\right)} \quad (25)$$

where $\frac{3H_t^2c^2}{8\pi G} \cong \left(M_tc^2\right)\left[\frac{4\pi}{3}\left(\frac{c}{H_t}\right)^3\right]^{-1} \cong \left(\frac{c^5}{2GH_t}\right)\left[\frac{3}{4\pi}\left(\frac{c}{H_t}\right)^{-3}\right]$.

At present,

$$(\rho_m)_0 \cong \frac{1}{c^2}\sqrt{\left(\frac{3H_0^2c^2}{8\pi G}\right)\left(aT_0^4\right)} \cong 6.25\times10^{-32}\text{ gram / cm}^3 \quad (26)$$

Based on the average mass-to-light ratio for any galaxy present matter density can be expressed with the following relation [5].

$$(\rho_m)_0 \cong 1.5\times10^{-32}\eta h_0 \text{ gram/cm}^3 \quad (27)$$

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 $\cong 0.68$. 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, $\eta h_0^{-1} \cong 9\pm1$ and for elliptical galaxies $\eta h_0^{-1} \cong 10\pm2$. For our galaxy inner part, $\eta h_0^{-1} \cong 6\pm2$. Thus the average ηh_0^{-1} is very close to 8 to 9 and its corresponding matter density is close to (5.55 to 6.24) $\times 10^{-32}$ gram/cm^3 and can be compared with the above proposed magnitude of 6.25×10^{-32} gram/cm^3.

7. The Cosmic Redshift and its New Interpretation

Note that in 1947 Edwin Hubble himself thought for a new mechanism for understanding the observed galactic redshift data [4]. 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 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.

$$E_G \cong \left(\frac{\lambda_0}{\lambda_G}\right)\left(\frac{hc}{\lambda_0}\right) \cong \frac{hc}{\lambda_G} \quad (28)$$

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

Now the observed cosmic redshift can be defined as follows.

$$\begin{aligned} z_0 &\cong \frac{\lambda_G-\lambda_0}{\lambda_0} \cong \left(\frac{\lambda_G}{\lambda_0}-1\right) \\ &\cong \frac{E_0-E_G}{E_G} \cong \left(\frac{E_0}{E_G}-1\right) \end{aligned} \quad (29)$$

If so the cosmological mechanism by which Hydrogen atom emits increased quanta of energy must be explored. It is for further study. At present in hydrogen atom the ground state potential energy of electron can be expressed in the following way.

$$\left(E_{\text{pot}}\right)_0 \cong -\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2c^2}{4\pi\varepsilon_0 G M_0}\right) \cong -2\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2 H_0}{4\pi\varepsilon_0 c}\right) \quad (30)$$

Here $\left(\frac{e^2 H_0}{4\pi\varepsilon_0 c}\right)$ 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. Accuracy mainly depends on the magnitude of the current Hubble constant. Characteristic ground state kinetic energy of electron can be expressed in the following way.

$$\begin{aligned} \left(E_{\text{kin}}\right)_0 &\cong \left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2c^2}{8\pi\varepsilon_0 G M_0}\right) \cong \left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2}{4\pi\varepsilon_0}\right)\left(\frac{c^2}{2GM_0}\right) \\ &\cong \left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2 H_0}{4\pi\varepsilon_0 c}\right) \end{aligned} \quad (31)$$

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

$$\begin{aligned} \left(E_{\text{tot}}\right)_0 &\cong -\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2c^2}{8\pi\varepsilon_0 G M_0}\right) \cong -\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2}{4\pi\varepsilon_0}\right)\left(\frac{c^2}{2GM_0}\right) \\ &\cong -\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2 H_0}{4\pi\varepsilon_0 c}\right) \end{aligned} \quad (32)$$

If $H_0 \cong 67$ km/sec/Mpc, $\left(E_{\text{tot}}\right)_0 \cong -12.89$ eV and if $H_0 \cong 71$ km/sec/Mpc, $\left(E_{\text{tot}}\right)_0 \cong -13.66$ eV. Based on this coincidence, this proposed new concept can be given some consideration and it can be suggested that the best value of H_0 lies in between 67 and 71 km/sec/Mpc. These relations seem to be independent of the reduced Planck's constant [12]. 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. Considering the concept of stationary orbits and jumping nature of electron, emitted photon energy can be expressed in the following way.

$$\left(E_{photon}\right)_0 \cong \left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2 H_0}{4\pi\varepsilon_0 c}\right)\left[\frac{1}{n_1^2}-\frac{1}{n_2^2}\right] \quad (33)$$

where $n_1 = n_2 \cong 1,2,3,..$ and $n_2 > n_1$. The best fit of H_0 can be obtained in the following way.

$$\left.\begin{aligned} &\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2 H_0}{4\pi\varepsilon_0 c}\right) \cong \frac{e^4 m_e}{32\pi^2\varepsilon_0^2\hbar^2} \\ &\text{and } H_0 \cong \frac{G m_p^2 m_e c}{2\hbar^2} \cong 70.738 \text{ km/sec/Mpc} \end{aligned}\right\} \quad (34)$$

In a unified picture [13, 14], in terms of the current 'primordial' cosmic angular velocity, electron's current quantum of angular momentum can be expressed as follows.

$$\begin{aligned} \hbar &\cong m_p\sqrt{\frac{G m_e c}{2H_0}} \cong m_p\sqrt{\left(G m_e\right)\left(\frac{G M_0}{c^2}\right)} \\ &\cong \frac{G m_p\sqrt{m_e M_0}}{c} \cong \hbar_0 \end{aligned} \quad (35)$$

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.

$$n\hbar \cong \left(n.m_p\right)\sqrt{\frac{G m_e c}{2H_0}} \cong \frac{G\left(n.m_p\right)\sqrt{m_e M_0}}{c} \quad (36)$$

where $n = 1,2,3,..$

At any time in the past - in support of the proposed cosmological red shift interpretation, above relations can be re-expressed as follows.

$$\left(E_{\text{pot}}\right)_t \cong -\left(\frac{H_0}{H_t}\right)\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2c^2}{4\pi\varepsilon_0 G M_0}\right) \cong -2\left(\frac{H_0}{H_t}\right)\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2 H_0}{4\pi\varepsilon_0 c}\right) \quad (37)$$

$$\left(E_{\text{kin}}\right)_t \cong \left(\frac{H_0}{H_t}\right)\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2 H_0}{4\pi\varepsilon_0 c}\right) \quad (38)$$

$$\left(E_{\text{tot}}\right)_t \cong -\left(\frac{H_0}{H_t}\right)\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2 H_0}{4\pi\varepsilon_0 c}\right) \quad (39)$$

This can be considered as the base for 'cosmological light emission mechanism'. At any time in the past, for any galaxy, emitted photon energy can be expressed as follows.

$$\left(E_{photon}\right)_t \cong \left(\frac{H_0}{H_t}\right)\left(\frac{e^2}{4\pi\varepsilon_0 G m_p^2}\right)\left(\frac{e^2 H_0}{4\pi\varepsilon_0 c}\right)\left[\frac{1}{n_1^2}-\frac{1}{n_2^2}\right] \cong E_G \quad (40)$$

Now galactic redshift can be expressed as follows.

$$z_0 \cong \left(\frac{\lambda_G}{\lambda_0}-1\right) \cong \left(\frac{E_0}{E_G}-1\right) \cong \left(\frac{H_t}{H_0}-1\right) \quad (41)$$

Hence,

$$H_t \cong \left(\frac{E_0}{E_G}\right) H_0 \cong \left(\frac{\lambda_G}{\lambda_0}\right) H_0 \quad (42)$$

This issue is for further study. At any time in the past, hypothetically, it is possible to express the cosmological ‘variable quantum of angular momentum’ of electron in the following way. Whether it is virtual or real to be confirmed from further study.

$$\hbar_t \cong \sqrt{\frac{M_0}{M_t}}.\hbar_0 \cong \sqrt{\frac{H_t}{H_0}}.\hbar_0 \cong \sqrt{\frac{\lambda_G}{\lambda_0}}.\hbar_0 \quad (43)$$

It may be noted that, throughout the cosmic evolution, Planck’s constant and the Uncertainty constant both can be considered as ‘constants’.

8. To Understand the Halting of the Expansion of the Black Hole Universe with Microscopic Relations

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. In this regard the characteristic and key relation can be expressed in the following way.

$$\frac{c^3}{2GM_0} \cong H_0 \text{ Or } \frac{c^3}{2GH_0} \cong M_0 \quad (44)$$

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.

$$\frac{c^3}{2GM_S} \cong H_S \text{ Or } \frac{c^3}{2GH_S} \cong M_S \quad (45)$$

Here H_S can be considered as the saturated angular velocity of the black hole universe at its ending stage of expansion and M_S can be considered as the saturated mass 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.

8.1. Role of the Uncertainty Relation

It is noticed that,

$$\frac{Gm_p m_e}{R_p H_0} \cong \frac{h}{4\pi} \quad (46)$$

Here $R_p \cong (0.84184 \text{ to } 0.87680)$ fm is the rms radius of proton [15]. After re-arranging, it can be expressed in the following way.

$$\left(\frac{2Gm_p}{c^2 R_p}\right)\frac{2\pi m_e c^2}{H_0} \cong \left(\frac{2Gm_p}{c^2 R_p}\right)\left[m_e c\left(2\pi\frac{c}{H_0}\right)\right] \cong h \quad (47)$$

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

$$H_S \Rightarrow \frac{4\pi G m_p m_e}{hR_p} \cong \frac{Gm_p m_e}{(h/4\pi)R_p}$$
$$\mathrm{H_S} \to (67.87 \text{ to } 70.69) \text{ km/sec/Mpc} \quad (48)$$

This is a remarkable fit and needs further study.

8.2. Role of the Classical Radius of Electron

It is noticed that,

$$\sqrt{\left(\frac{2G\sqrt{m_p m_e}}{c^2}\right)\left(\frac{c}{H_0}\right)} \cong \left(\frac{e^2}{4\pi\varepsilon_0 m_e c^2}\right) \quad (49)$$

$\left(\frac{e^2}{4\pi\varepsilon_0 m_e c^2}\right)$ 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.

$$\left(\frac{c}{H_S}\right) \Rightarrow \left(\frac{e^2}{4\pi\varepsilon_0 m_e c^2}\right)^2 \left(\frac{c^2}{2G\sqrt{m_p m_e}}\right) \quad (50)$$

$$H_S \Rightarrow \frac{2G\sqrt{m_p m_e}}{c}\left(\frac{4\pi\varepsilon_0 m_e c^2}{e^2}\right)^2 \cong 67.533 \text{ km/sec/Mpc} \quad (51)$$

This is also a remarkable fit and needs further study.

8.3. Role of the Characteristic Nuclear Potential Radius

It is noticed that,

$$\frac{G\sqrt{M_0\sqrt{m_p m_e}}}{c^2} \cong \sqrt{\left(\frac{GM_0}{c^2}\right)\left(\frac{G\sqrt{m_p m_e}}{c^2}\right)}$$
$$\cong 1.4\times10^{-15} \text{ m} \cong \mathrm{R}_n \quad (52)$$

R_n is nothing but the presently believed characteristic nuclear potential radius [16]. By this time if the expanding black hole universe is coming to a halt, then above relation can be re-expressed as follows.

$$\frac{G\sqrt{M_S\sqrt{m_p m_e}}}{c^2} \Rightarrow R_n \tag{53}$$

$$H_S \Rightarrow \frac{G\sqrt{m_p m_e}}{2cR_n^2} \tag{54}$$

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

8.4. Role of the 'Inverse' of the Fine Structure Ratio

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

$$(E_T)_0 \cong aT_0^4 \cdot \frac{4\pi}{3}\left(\frac{c}{H_0}\right)^3 \tag{55}$$

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

$$\frac{(E_T)_0}{2} \cong \frac{1}{2}\left[aT_0^4 \cdot \frac{4\pi}{3}\left(\frac{c}{H_0}\right)^3\right] \tag{56}$$

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

$$(E_e)_0 \cong \frac{e^2}{4\pi\varepsilon_0(c/H_0)} \tag{57}$$

If H_0 is close to 66.893 km/sec/Mpc and $T_0 \cong 2.72548\ {}^0K$, it is noticed that,

$$\ln\sqrt{\frac{\left[(E_T)_0/2\right]}{(E_e)_0}} \cong 137.167 \tag{58}$$

In atomic and nuclear physics, the fine-structure ratio (α) is a fundamental physical constant namely the coupling constant characterizing the strength [17] 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. Note that large dimensionless constants and compound physical constants reflect an intrinsic property of nature [18]. By this time if the expanding black hole universe is coming to a halt, then above relation can be re-expressed as follows.

$$\ln\sqrt{\frac{\left[(E_T)_0/2\right]}{(E_e)_0}} \cong \ln\sqrt{\frac{\left[(E_T)_S/2\right]}{(E_e)_S}} \Rightarrow \left(\frac{1}{\alpha}\right) \tag{59}$$

$(E_T)_S$ 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 of cosmic expansion.

9. Conclusion

Based on the short comings of standard cosmology, Friedmnn's misleading density classification scheme, and proposed concepts, relations & data fitting - model of black hole cosmology can be given 99% priority [19-25]. In view of the concepts and applications proposed in sections (4) to (8) and with reference to the zero rate of change in inverse of the fine structure ratio (from ground based experiments), zero rate of change in the 'current CMBR temperature' (from Cobe/Planck satellite data) and zero rate of change in the 'current Hubble's constant' (from Cobe/Planck 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. 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. 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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References

[1] Friedmann. A. On the Curvature of Space. General Relativity and Gravitation 31 (12): 1991-2000. 1999

[2] Hawking S.W. A Brief History of Time. Bantam Dell Publishing Group. 1988

[3] Hubble E. P, A relation between distance and radial velocity among extra-galactic nebulae, PNAS, 1929, vol. 15, 1929, pp.168-173.

[4] Hubble, E.P, The 200-inch telescope and some problems it may solve. PASP, 59, pp153-167, 1947.

[5] J. V. Narlikar. Introduction to cosmology. Cambridge Univ Press, 2002.

[6] U. V. S. Seshavatharam. Physics of rotating and expanding black hole universe. Progress in Physics. April, p 7-14, (2010).

[7] U.V.S. Seshavatharam. The Primordial Cosmic Black Hole and the Cosmic Axis of Evil. International Journal of Astronomy, 1(2): 20-37, (2012).

[8] Michael J. Longo, Detection of a Dipole in the Handedness of Spiral Galaxies with Redshifts z 0.04, Phys. Lett. B 699, 224-229 2011.

[9] Christopher S. Reynolds. Astrophysics: Black holes in a spin. Nature. 494, 432–433 (28 February 2013)

[10] C. L. Bennett et al, Nine-Year Wilkinson Microwave Anisotropy Probe (WMAP) Observations: Final Maps and Results. Submitted to Astrophysical Journal Supplement Series. http://arxiv.org/abs/1212.5225v1

[11] The Accelerating Universe. The Royal Swedish Academy of sciences. 2011 Nobel prize in physics. http://www.nobelprize.org/nobel_prizes/physics/laureates/2011/advanced-physicsprize2011.pdf

[12] N. Bohr. On the Constitution of Atoms and Molecules Systems containing only a Single Nucleus. (Part-2) Philos. Mag. 26, 1913, p 476.

[13] David Gross, Einstein and the search for Unification. Current science, Vol. 89, No. 2005, p 12.

[14] Abdus Salam. Einstein's Last Dream: The Space -Time Unification of Fundamental Forces, Physics News, 12(2):36, June 1981.

[15] Michael O. Distler et al. The RMS Charge Radius of the Proton and Zemach Moments. Phys. Lett.B. 696: 343-347,2011

[16] Geiger H and Marsden E. On a diffuse reaction of the particles. Proc. Roy. Soc., Ser. A 82: 495-500, 1909.

[17] J. Beringer et al. Particle Data Group. Phys. Rev. D86, 010001 (2012)

[18] P. A. M. Dirac. The cosmological constants. Nature, 139, 1937, p 323.

[19] Zhang, Tianxi. Cosmic microwave background radiation of black hole universe. Astrophysics and Space Science, Volume 330,Issue 1, pp 157-165. (2010).

[20] Poplawski, N. J. Radial motion into an Einstein-Rosen bridge. Physics Letters B 687 (23): 110-113. (2010).

[21] Poplawski, N. J . Energy and momentum of the Universe. Class. Quantum Grav. 31, 065005 (2014).

[22] Seshavatharam, U. V. S. & Lakshminarayana, S., On the Role of Hubble Volume in Black Hole Cosmology & Final Unification. Prespacetime Journal, February 2014, Volume 5, Issue 2, pp. 148-173.

[23] U. V. S. Seshavatharam, S. Lakshminarayana, Hubble Volume and the Fundamental Interactions, International Journal of Astronomy, Vol. 1 No. 5, 2012, pp. 87-100.

[24] U. V. S. Seshavatharam, S. Lakshminarayana, B.V.S.T. Sai. Is red shift an index of galactic'atomic light emission' mechanism? International Journal of Physics, Vol. 1, No.3, 49-64, (2013).

[25] U. V. S. Seshavatharam, S. Lakshminarayana Microscopic Physical Phenomena in Black Hole Cosmos Rotating at Light Speed. Prespacetime Journal. October 2013, Volume 4, Issue 9, pp. 884-922.