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Light Speed Expansion and Rotation of a Primordial Black Hole Universe having Internal Acceleration

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Authors' contributions

This work was carried out in collaboration between both authors. Author UVSS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author SL managed the analyses of the study. Both authors read and approved the final manuscript.

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ABSTRACT

With reference to primordial black holes, an attempt has been made to develop a practical model of cosmology. Main features of this integrated model are: Eternal role of Planck scale, light speed expansion and rotation of a primordial cosmic black hole, slow thermal cooling, internal acceleration and anisotropy. At any stage of cosmic expansion, there exists a tight correlation between cosmic angular velocity and cosmic temperature. At $H_0 \cong 70 \text{ km/Mpc/sec}$, present cosmic radius seems to be 140.56 times higher than the Hubble radius, angular velocity seems to be 140.56 times smaller than the Hubble parameter and cosmic age seems to be 140.56 times the Hubble age. An attempt is made to estimate galactic dark mass using MOND relation and cosmic angular velocity. Current cosmic graviton wave length seems to be around 4.9 mm. This model is free from 'big bang', 'inflation', 'dark energy', 'flatness' and 'red shift' issues.

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1. INTRODUCTION

We would like to emphasize the fact that, the basic principles of cosmology were developed when the subject of cosmology was in its budding stage. Friedmann made two simple assumptions about the universe [1,2]. 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 context, Hawking expressed that [2]: "There is no scientific evidence for the Friedmann's second assumption. We believe it only on the 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".

In our earlier and recent published papers [3-16] we tried to highlight the basic drawbacks of big bang, inflation and galactic red shift in various possible ways. As of now, theoretically and observationally, with respect to inflation, isotropy, expansion speed, dark matter, dark energy and rotation, whole subject of cosmology is being driven into many controversies and dividing cosmologists into various groups with difference of opinions. On the other hand, very unfortunate thing is that, quantum cosmology point of view, 'as a whole', progress is very poor [17]. Instead of discussing about the controversies, we would like to propose a new model which can pave a new way for understanding and correlating astrophysical and cosmological observations in terms of quantum mechanics and general theory of relativity in a broad sense. It needs further study.

With three simplified assumptions, an attempt has been made to develop a practical model of the universe. As so many galaxies are rotating and all the cosmic observations are being carried out with photons, we consider a light speed expanding [11-16,18-22] and light speed rotating universe. As galaxies are the key building blocks of the evolving universe and as all galaxies constitute massive rotating black holes at their centers, we consider a growing and rotating black hole universe model [3-16]. That is why we call it as a practical model. Interesting point to be noted is that, our model is absolutely free from 'cosmic red shift' concept. Most important point to be noted is that, we have developed a very tight quantum gravity relation for correlating cosmic temperature and Hubble parameter independent of galactic red shifts and galactic distances. It can be applied to different time periods of the past.

2. REASONS FOR CHOOSING LIGHT SPEED

Based on the following reasons, we consider light speed as a special feature of cosmic expansion and rotation.

1) All cosmic observations are being studied with photons.
2) It is well believed that gravity propagates with light speed.
3) It is well established that electromagnetic interaction propagates with light speed.
4) It is well proved that, light speed is the ultimate speed of material particles.
5) So far, it has not yet been possible physically to measure the actual galactic receding speeds.
6) So far, it has not yet been possible to demonstrate and distinguish 'space without matter' and 'matter without space'. In this ambiguous situation, without knowing the origins of 'space' and 'matter', it is quite illogical to say that, space drags massive galaxies at super luminal speeds.
7) So far, either at microscopic level or at macroscopic level, it has not yet been possible to establish a common understanding among quantum mechanics and gravity.

3. REASONS FOR CONSIDERING UNIVERSE AS A PRIMORDIAL GROWING AND ROTATING BLACK HOLE

Based on the following reasons, we consider a primordial growing and rotating black hole universe.

1) Mass and size pertaining to pre and post big bang [15,16,23] are unclear.
2) Whether Planck scale is associated with big bang or big bang is associated with Planck scale is also unclear.
3) As there exist no clear reasons for understanding the occurrence of exponential expansion, cosmologists are having different opinions on cosmic inflation [24].
4) So far, it has not yet been possible to establish solid connection between Planck scale and current physical parameters of the observable universe.
5) At any given cosmic time, the product of currently believed 'critical density' and 'Hubble volume' gives a characteristic cosmic mass, and can be called as 'Hubble mass'. Of interest, the Schwarzschild radius of this 'Hubble mass' appears to coincide with the currently believed 'Hubble length'. Most cosmologists believe that this is merely a coincidence. Here we wish to emphasize the possibility that this coincidence might imply a deep inter-connection between cosmic geometry and other cosmological physical phenomena.
6) At any stage of cosmic expansion, if the universe maintains a closed boundary to have its size minimum, it is having an option to follow the "Schwarzschild radius" at that time. At any stage of cosmic evolution, if one is willing to consider the 'Schwarzschild radius' of the expanding black hole universe as its minimum possible radius, corresponding other characteristic cosmic physical parameters can be estimated/predicted easily and can be compared with time to time cosmological observations.
7) Whether universe is giving birth to black holes or black hole is the seed of any universe is not yet clear [25]. When the early universe was able to create a number of galactic black holes or primordial black holes, it may not be a big problem for the whole universe to behave like a big primordial evolving black hole. With reference to the current concepts of modern cosmology, probability of 'this' to happen may be zero, but its possibility cannot be ruled out.
8) Formation scheme of primordial black holes is entirely different from stellar black holes [26] and early stage quantum fluctuations seem to play a vital role in understanding the nature of primordial black holes.
9) Whether galactic central halos are primordial black holes or gravitationally collapsed objects is not yet clear [27].
10) So far, it has not yet been possible to establish a limiting mass range for stellar black holes and primordial black holes.

4. LIST OF SYMBOLS

At any stage of cosmic evolution,

1) Cosmic time = t
2) Cosmic Hubble parameter = H_t
3) Cosmic angular velocity = ω_t
4) Ratio of Hubble parameter to angular velocity = Υ_t
5) Cosmic radius = R_t
6) Cosmic mass = M_t
7) Cosmic volume = Φ_t
8) Cosmic temperature = T_t
9) Galactic distance from cosmic center = $\left(r_{gal}\right)_t$
10) Galactic receding speed from cosmic center = $\left(r_{gal}\right)_t$
11) Increment in expansion distance = $\Delta\left(d_{\exp}\right)_t$
12) Distance from cosmic center = $\left(r_d\right)_t$
13) Wave length of cosmic graviton = $\left(\lambda_{gw}\right)_t$
14) Frequency of cosmic graviton = $\left(\upsilon_{gw}\right)_t$
15) Galactic star rotation speed = V_{rot}
16) Galactic angular velocity = ω_{gal}
17) Estimated visible mass of galaxy = M_{vis}
18) Estimated total mass of galaxy = M_{total}
19) Ratio of total mass of galaxy and visible mass of galaxy = Total mass factor = x
20) Estimated dark mass of galaxy = M_{dark}
21) %Dark mass of galaxy = $\left(\frac{x-1}{x}\right)\times 100$
22) Escape velocity of a galactic test particle= V_{esc}
23) Mass of a galactic test particle= m

Note: Planck scale symbols can be understood with a subscript 'pl' and current symbols can be understood with a subscript of '0'.

5. THREE SIMPLE ASSUMPTIONS

We propose the following three assumptions.

Assumption-1: Right from the beginning of Planck scale, as a growing black hole, universe is expanding with speed of light and rotating with speed of light from and about the cosmic center. It can be expressed with,

$$R_t \cong \frac{2GM_t}{c^2} \cong \frac{c}{\omega_t} \tag{1}$$

$$\therefore\ M_t \cong \frac{c^3}{2G\omega_t} \tag{2}$$

Assumption-2: At any stage of cosmic evolution, ratio of Hubble parameter to angular velocity can be expressed as,

$$\frac{H_t}{\omega_t} \cong \left\{1+\ln\left(\frac{H_{pl}}{H_t}\right)\right\} \cong \Upsilon_t \tag{3}$$

where $H_{pl} \cong \frac{c^3}{2GM_{pl}} \cong \frac{1}{2}\sqrt{\frac{c^5}{G\hbar}} \cong 9.2746\times 10^{42}\ \text{sec}^{-1}$

and $M_{pl} \cong \sqrt{\frac{\hbar c}{G}}$.

Assumption-3: Right from the beginning of Planck scale, at any stage of cosmic expansion, cosmic matter energy density and thermal energy density are equal in magnitude and can be expressed as follows.

Let, Cosmic volume = $\Phi_t \cong \left(\frac{4\pi}{3}R_t^3\right)$ (4)

Based on relations (2) and (4), cosmic matter energy density can be expressed as,

$$\left.\begin{aligned}\frac{(\rho_{mat})_t c^2}{\Phi_t} &\cong \left(\frac{c^5}{2G\omega_t}\right)\div\left(\frac{4\pi}{3}R_t^3\right)\\ &\cong \frac{3c^5}{8\pi G\omega_t R_t^3} \cong \frac{3c^5}{8\pi G}\left(\frac{c}{\omega_t}\right)^{-3} \cong \frac{3\omega_t^2 c^2}{8\pi G}\end{aligned}\right\} \tag{5}$$

Thus,

$$aT_t^4 \cong \frac{(\rho_{mat})_t c^2}{\Phi_t} \cong \frac{3\omega_t^2 c^2}{8\pi G} \cong \frac{1}{\Upsilon_t^2}\left(\frac{3H_t^2 c^2}{8\pi G}\right) \tag{6}$$

6. EXPRESSIONS FOR COSMIC TEMPERATURE AND AGE

Rewriting relation (6) with respect to the radiation energy density constant, $a \cong \frac{\pi^2 k_B^4}{15\hbar^3 c^3}$ and considering relation (2), cosmic temperature can be estimated in the following way [11,13,28].

Based on assumption (3) and relations (4) and (6),

$$\frac{\pi^2 k_B^4 T_t^4}{15\hbar^3 c^3} \cong \frac{3\omega_t^2 c^2}{8\pi G} \tag{7}$$

By proceeding in the following way, a very simple expression for cosmic temperature can be obtained.

$$\left.\begin{aligned}k_B^4 T_t^4 &\cong \left(\frac{45}{8\pi^3}\right)\frac{\omega_t^2\hbar^3 c^5}{G}\\ &\cong \left(\frac{45}{8\pi^3}\right)\frac{\omega_t^2\hbar^3 c^5}{G}\times\left(\frac{\hbar c}{\hbar c}\right)\\ &\cong \left(\frac{45}{8\pi^3}\right)\frac{\omega_t^2\hbar^4 c^6}{G\hbar c}\\ &\cong \left(\frac{45}{8\pi^3}\right)\frac{\omega_t^2\hbar^4 c^6}{G\hbar c}\times\left(\frac{G}{G}\right)\\ &\cong \left(\frac{45}{8\pi^3}\right)\frac{\omega_t^2\hbar^4 c^6}{G^2}\left(\frac{\hbar c}{G}\right)^{-1}\\ &\cong \left(\frac{45}{8\pi^3}\right)\frac{\omega_t^2\hbar^4 c^6}{G^2}\left(\sqrt{\frac{\hbar c}{G}}\right)^{-2}\times\left(\frac{4G^2c^6}{4G^2c^6}\right)\\ &\cong \left(\frac{45}{32\pi^3}\right)\frac{\hbar^4 c^{12}}{G^4}\left(\sqrt{\frac{\hbar c}{G}}\right)^{-2}\times\left(\frac{c^3}{2G\omega_t}\right)^{-2}\\ &\cong \left(\frac{45}{32\pi^3}\right)\frac{\hbar^4 c^{12}}{G^4 M_{pl}^2 M_t^2}\end{aligned}\right\} \tag{8}$$

Hence,

$$T_t \cong \left(\frac{45}{32\pi^3}\right)^{\frac{1}{4}}\frac{\hbar c^3}{k_B G\sqrt{M_t M_{pl}}} \cong \frac{0.4615\hbar c^3}{k_B G\sqrt{M_t M_{pl}}} \tag{9}$$

As universe is always expanding with speed of light, $R_t \cong ct$. Hence,

$$t \cong \frac{R_t}{c} \cong \frac{1}{\omega_t} \cong \frac{\Upsilon_t}{H_t} \tag{10}$$

7. CURRENT VALUES AT $H_0 \cong 70$ km/Mpc/sec

Considering $H_0 \cong 70$ km/Mpc/sec,

$$\Upsilon_0 \cong \left\{1+\ln\left(\frac{H_{pl}}{H_0}\right)\right\} \cong 140.5632 \tag{11}$$

$$\omega_0 \cong H_0 \left\{1+\ln\left(\frac{H_{pl}}{H_0}\right)\right\}^{-1} \cong \frac{H_0}{\Upsilon_0} \cong 1.61394\times10^{-20} \text{ rad/sec} \tag{12}$$

$$R_0 \cong \frac{c}{\omega_0} \cong \Upsilon_0\left(\frac{c}{H_0}\right) \cong 1.85752\times10^{28} \text{ m} \tag{13}$$

$$M_0 \cong \frac{c^3}{2G\omega_0} \cong 1.251\times10^{55} \text{ kg} \tag{14}$$

$$T_0 \cong \frac{0.4615\hbar c^3}{k_B G\sqrt{M_0 M_{pl}}} \cong 2.72761 \text{ K} \tag{15}$$

$$t_0 \cong \frac{1}{\omega_0} \cong \frac{\Upsilon_0}{H_0} \cong 1963.4 \text{ Billion years} \tag{16}$$

8. COSMIC ROTATION AND CURRENT COSMIC ROTATIONAL KINETIC ENERGY

8.1 Cosmic Rotation

As 'spin' is a basic property of quantum mechanics, from the subject point of quantum gravity, universe must have 'rotation'. If it is assumed that, universe is a black hole, it is quite natural to expect 'cosmic rotation'. Recent observations clearly indicate the possibility of 'light speed' spinning black holes.

The first experimental evidence of the Universe rotation was done by Birch in 1982 evidently [29]. According to Birch, there appears to be strong evidence that the Universe is anisotropic on a large scale, producing position angle offsets in the polarization and brightness distributions of radio sources. These can probably be explained on the basis of a rotation of the Universe with an angular velocity of approximately 10^{-13} rad/year. In our model, current cosmic angular velocity is 5.0932×10^{-13} rad/year. Observational effects of current cosmic rotation can be understood with the works of Obukhov [30], Godlowski [31], Longo [32] and Chechin [33].

Yuri N. Obukhov says: "Whether our universe is rotating or not, it is of fundamental interest to understand the interrelation between rotation and other aspects of cosmological models as well as to understand the observational significance of an overall rotation".

According to Michael Longo the universe has a net angular momentum and was born in a spin.

Whittaker says [34]: "however, that any of the mathematical-physical theories that have been put forward to explain spin (rotation) in the universe has yet won complete and universal acceptance; but progress has been so rapid in recent years that it is reasonable to hope for a not long-delayed solution of this fundamental problem of cosmology".

According to T. Valery and S. V. Timkov, current universe is rotating with light speed and angular velocity equal to the current Hubble parameter [35].

Very recent and advanced studies of Lior Shamir suggest [36] that, the distribution of galaxy spin directions in SDSS and Pan-STARRS shows patterns in the asymmetry between galaxies with opposite spin directions and can be considered as an evidence for large-scale anisotropy and an indication for a rotating universe.

8.2 Cosmic Rotational Kinetic Energy

Current total matter density,

$$(\rho_{tot})_0 \cong \left(\frac{c^3}{2G\omega_t}\right) \div \left(\frac{4\pi}{3}R_0^3\right) \cong 4.659\times10^{-31} \text{ kg/m}^3 \tag{17}$$

As current matter density is very very small, considering current universe as a thin spherical shell, its rotational kinetic energy can be estimated with a relation of the form,

$$(KE_{rot})_0 \cong \frac{1}{2}I_0\omega_0^2 \cong \frac{1}{3}M_0R_0^2\omega_0^2 \cong \frac{1}{3}M_0c^2 \quad \text{where, } I_0 \cong \frac{2}{3}M_0R_0^2 \tag{18}$$

9. UNDERSTANDING COSMIC DARK MATTER

Dark mater [37] can be understood in two different ways. One way of understanding is based on thermal cooling of the universe [38]. Another way of understanding is based on the receding galaxy's increasing relativistic mass.

9.1 Deep Frozen Mass of a Galaxy

Current cosmic temperature is 2.727 K and current cosmic age is 1963.4 billion years. Based on these points, starting from the formation of hydrogen (3000 K), formation of condensed star dust [39] (1100 K) and the melting point of hydrogen (14 K) on wards, it is possible to guess that, most of the cosmic matter can be in the form of very deep frozen state. In general, at sub zero temperatures, matter can show inability for photonic interactions. Frozen cosmic matter can be qualitatively considered as the currently believed dark matter. Heating effects caused by so many stars, some of the frozen matter exposed to star heat might have been converted to visible matter continuously.

Formation of galactic halos and galactic envelopes might be absorbing some of the frozen matter on a regular basis. Galaxy which constitutes many stars with high temperatures will try to heat the frozen matter in a short run. After a long run, old galaxies that constitute cold stars can have more frozen matter. Galaxies that constitute young stars can have less frozen matter. Either an old galaxy or a new galaxy, galactic halos can absorb more frozen matter due to their strong attractive nature.

9.2 Relativistic Mass of a Galaxy

It may also be noted that, considering special theory of relativity, there is a possibility of relativistic increase in galactic mass. Clearly speaking, galaxies having high receding speeds may have higher relativistic masses compared to galaxies having lower relativistic speeds. This kind of galactic mass increasing mechanism seems to have an interesting role in understanding actual galactic mass. But without understanding the internal distribution mechanism of increasing mass, it may not be possible to understand or distinguish the mass of galactic halo and total mass of stars enveloped by the galaxy. Very complicated point to be understood is – 'nature' of increasing mass – whether the increased mass constitutes new kind of particles or a kind of inertia or currently believed dark matter.

10. TO FIT OBSERVED DARK MATTER DENSITY AND BARYONIC MATTER DENSITY

With reference to the recombination point of 3000 K, star dust condensation temperature of 1100 K, observed baryonic matter density and dark matter density [40] can be fitted with the following relations.

10.1 Current Baryonic Matter Density

Current baryonic matter density can be fitted with the following relation.

$$\begin{aligned}(\rho_{bar})_0 &\cong \beta\sqrt{\left(\frac{3\omega_0^2}{8\pi G}\right)\left(\frac{3H_0^2}{8\pi G}\right)} \cong \beta\left(\frac{3\omega_0 H_0}{8\pi G}\right) \\ &\cong 3.93\times10^{-28}\ \text{kg/m}^3 \cong 4.27\%\ \text{of}\ \left(\frac{3H_0^2}{8\pi G}\right)\end{aligned} \tag{19}$$

$$\text{where, } \beta \cong \ln\left(\frac{3000\ \text{K}}{2.725\ \text{K}}\right) - 1 \cong 6.0$$

10.2 Current Dark Matter Density

Current dark matter density can be fitted with the following relation.

$$\begin{aligned}(\rho_{dar})_0 &\cong \beta^2\sqrt{\left(\frac{3\omega_0^2}{8\pi G}\right)\left(\frac{3H_0^2}{8\pi G}\right)} \cong \beta^2\left(\frac{3\omega_0 H_0}{8\pi G}\right) \\ &\cong 2.36\times10^{-27}\ \text{kg/m}^3 \cong 25.61\%\ \text{of}\ \left(\frac{3H_0^2}{8\pi G}\right)\end{aligned} \tag{20}$$

$$\text{where } \beta^2 \cong \left(\ln\left(\frac{3000\ \text{K}}{2.725\ \text{K}}\right) - 1\right)^2 \cong 36.0$$

$$\frac{(\rho_{dar})_0}{(\rho_{bar})_0} \cong \beta \cong \ln\left(\frac{3000\ \text{K}}{2.725\ \text{K}}\right) - 1 \tag{21}$$

In a trial-error method we have developed these relations. Interesting point to be noted is that, at a temperature of 1100 K, the factor $\beta \cong \ln\left(\frac{3000\ \text{K}}{1100\ \text{K}}\right) - 1 \cong 0.$ From this it can be interpreted that, from 1100 K onwards, condensates of baryonic matter and dark matter start to form in the envelope of galaxies. It needs further study.

11. TO UNDERSTAND COSMIC RED SHIFT ASSOCIATED WITH COSMIC CURRENT AND PAST TEMPERATURES

With reference to the light emitted from first hydrogen atoms, we define the following two ad hoc relations.

Let, $$x_t \cong 1+\ln\left(\frac{R_t}{R_{pl}}\right) \quad (22)$$

where R_{pl} is the Planck scale cosmic radius.

$$Z \cong \sqrt{\exp\left(x_0-x_t\right)-1} \quad (23)$$

Based on these two ad hoc definitions, it is possible to show that,

$$\left.\begin{aligned} Z &\cong \sqrt{\exp\left\{\left[1+\ln\left(\frac{R_0}{R_{pl}}\right)\right]-\left[1+\ln\left(\frac{R_t}{R_{pl}}\right)\right]\right\}-1} \\ &\cong \sqrt{\exp\left\{\left(\ln\left(\frac{R_0}{R_{pl}}\right)-\ln\left(\frac{R_t}{R_{pl}}\right)\right)\right\}-1} \\ &\cong \sqrt{\exp\left\{\ln\left(\frac{R_0}{R_t}\right)\right\}-1} \cong \sqrt{\frac{R_0}{R_t}-1} \end{aligned}\right\} \quad (24)$$

With respect to the proposed assumptions, it is clear that at any stage of cosmic expansion,

1) Cosmic radius is inversely proportional to cosmic angular velocity.
2) Cosmic angular velocity is directly proportional to squared cosmic temperature.

Hence,

$$Z \cong \sqrt{\frac{R_0}{R_t}-1} \cong \sqrt{\frac{\omega_t}{\omega_0}-1} \cong \sqrt{\frac{T_t^2}{T_0^2}-1} \cong \frac{T_t}{T_0}-1 \quad (25)$$

where T_t is the past cosmic temperature and T_0 is the current cosmic temperature.

$$\therefore\ Z+1 \cong \frac{T_t}{T_0} \quad (26)$$

12. TO UNDERSTAND HUBBLE'S LAW AND TO LOCATE THE COSMIC CENTER

Based on first assumption and special theory of relativity, from and about the cosmic center, for any materialistic galaxy, its current receding speed can be understood in the following way.

$$\left(v_{gal}\right)_0 \cong \left(\frac{\left(r_{gal}\right)_0}{R_0}\right)c \cong \left(r_{gal}\right)_0 \omega_0 \cong \left(\frac{1}{\Upsilon_0}\right)\left(r_{gal}\right)_0 H_0 \quad (27)$$

In this way qualitatively Hubble's [41] law can be understood. Since ω_0 is known, by knowing the actual galactic receding speed, its distance from the cosmic center can be estimated. By estimating the cosmic radial distances of galaxies along with their locations, it seems possible to locate the cosmic center. If any galaxy's actual receding speed is found to be faster than speed of light, our model can be falsified.

13. TO ESTIMATE CURRENT COSMIC GRAVITATIONAL WAVE LENGTH

With reference to current cosmic mass and Planck mass, wave length of current gravitational waves [42] can be obtained as follows.

Our idea is that, at any stage of cosmic evolution, 'evolving universe' is an 'internal accelerating' object and wavelength of cosmic graviton is equal to the 2π times the geometric mean of radius of universe at time t and Planck scale radius. It can be expressed as,

Based on this idea, at present,

$$\begin{aligned} \left(\lambda_{gw}\right)_0 &\cong 2\pi\sqrt{R_0R_{pl}} \cong 2\pi\left(\frac{2G\sqrt{M_0M_{pl}}}{c^2}\right) \\ &\cong \frac{4\pi G\sqrt{M_0M_{pl}}}{c^2} \cong 0.0048687\text{ m} \end{aligned} \quad (28)$$

Corresponding frequency and energy can be expressed as,

$$\begin{aligned} \left(\nu_{gw}\right)_0 &\cong \frac{c}{\left(\lambda_{gw}\right)_0} \cong \frac{c}{2\pi\sqrt{R_0R_{pl}}} \\ &\cong \frac{c^3}{4\pi G\sqrt{M_0M_{pl}}} \cong 61.5755\text{ GHz} \end{aligned} \quad (29)$$

$$\left(E_{gw}\right)_0 \cong \frac{\hbar c^3}{2G\sqrt{M_0 M_{pl}}} \cong \frac{\hbar c}{\sqrt{R_0 R_{pl}}} \cong 0.000254656 \text{ eV} \quad (30)$$

14. UNDERSTANDING COSMIC ANISOTROPY

As universe is always expanding at speed of light, at any stage of expansion, cosmic boundary expands by 3×10^8 m in one second. In between the cosmic center and cosmic boundary, expansion distance covered in one second can be expressed as,

$$\Delta\left(d_{\exp}\right)_t \cong \frac{\left(r_d\right)_t}{R_t}\left(3\times10^8\right) \text{ m} \quad (31)$$

where,

$\Delta\left(d_{\exp}\right)_t$ = Increment in expansion distance at time t.

$\left(r_d\right)_t$ = Distance from cosmic center at time t.

R_t = Cosmic radius at time t.

Clearly speaking,

1) Distance moved near to cosmic boundary is more compared to distance moved near to cosmic center.
2) Rate of volume change near to cosmic boundary is higher than the rate of volume change near to cosmic center.
3) Anisotropy [36,43] gradually increases from cosmic center to cosmic boundary.

15. UNDERSTANDING (INTERNAL) COSMIC ACCELERATION

According to Saul Perlmutter, Adam Riess and Brian Schmidt, observable universe is accelerating [44,45]. Clearly speaking, expansion of the universe is such that the velocity at which a distant galaxy is receding from the observer is continuously increasing with time. It can be understood in the following way.

Based on relation (27) and with reference to two time periods $\left(t_2 > t_1\right)$, ratio of galactic receding speeds can be expressed as,

$$\frac{\left(v_{gal}\right)_{t_2}}{\left(v_{gal}\right)_{t_1}} \cong \left(\frac{\left(r_{gal}\right)_{t_2}}{\left(r_{gal}\right)_{t_1}}\right)\left(\frac{R_{t_1}}{R_{t_2}}\right) \quad (32)$$

where,

$\left(v_{gal}\right)_{t_1}$ and $\left(v_{gal}\right)_{t_2}$ = Galactic receding speeds corresponding to $\left(t_1, t_2\right)$ respectively where $\left(v_{gal}\right)_{t_2} > \left(v_{gal}\right)_{t_1}$.

$\left(r_{gal}\right)_{t_1}$ and $\left(r_{gal}\right)_{t_2}$ = Galactic distances corresponding to $\left(t_1, t_2\right)$ respectively where $\left(r_{gal}\right)_{t_2} > \left(r_{gal}\right)_{t_1}$.

R_{t_1} and R_{t_2} = Theoretical cosmic radii corresponding to $\left(t_1, t_2\right)$ respectively where $\left(R_{t_2} > R_{t_1}\right)$.

Clearly speaking,

1) Within the cosmic horizon, second by second, galactic receding speeds are increasing and resemble a kind of internal cosmic acceleration.
2) Acceleration seems to be higher near to cosmic center and gradually reaches to zero at horizon.
3) Hubble's law pertaining to two increasing time periods seems to be a natural consequence of internal cosmic acceleration.
4) Cosmic horizon is always expanding at speed of light.

16. TO RELINQUISH DARK ENERGY

If it is assumed that, universe is always expanding with speed of light, then, considering 'dark energy' like concepts need not be required [46]. Proceeding further, till today, no cosmological observation or no ground based experiment could shed light on the physical nature of dark energy.

17. UNDERSTANDING COSMIC AGE

Observable cosmic radius is just 2.2 times the Hubble radius and corresponding cosmic age is $\left(1/H_0\right)$. Our model result of cosmic radius is 140.5 times the Hubble radius and corresponding light speed cosmic age is 140.5 times $\left(1/H_0\right)$. In this way, our model result of cosmic age can be justified. We would like to emphasize that,

1) Modern cosmological observations are limited to 2.2 times the Hubble radius and needs further study.

2) Time is a dynamic and emerging cosmic parameter.
3) Cosmic age depends on the model under consideration.
4) One should not worry about the absolute age of cosmic age.

18. UNDERSTANDING NUCLEO-SYNTHESIS

Based on relations (1) to (16) and by assuming appropriate density range or temperature range that is required for formation of nucleons and atoms, cosmic physical parameters pertaining to nucleosynthesis can be understood [47]. For example, cosmic age corresponding to a temperature of 10^{10} K is 4.61 sec. It needs further study. Estimated cosmic age corresponding to 3000 K is 1.6223×10^{6} years. This estimation is 4.27 times higher than the current estimation of 3.8×10^{5} years. Clearly speaking, starting from the Planck scale, without considering 'inflation' like cooling pattern, our model follows a slow thermal cooling pattern throughout the cosmic evolution.

19. INFERENCES OF GROWING COSMIC SINGULARITY

Based on the proposed assumptions and with reference to the above relations, we would like to say that,

1) Earth, Solar family, Milky way and all other galaxies are living inside the proposed black hole universe.
2) There is matter and space outside the proposed growing and rotating primordial black hole universe.
3) The growing and rotating primordial black hole universe always sucks matter inward and thus it grows on with increasing suction rate.
4) At poles, inward matter flow rate is maximum and at equator, inward matter flow rate is zero. Thus, starting from poles to equator, inward matter flow rate gradually decreases.

20. TO DEVELOP PRACTICAL METHODS FOR UNDERSTANDING GROWING COSMIC SINGULARITY

We would like to propose the following points for understanding cosmic singularity.

1) To study cosmic anisotropy on very large cosmic distances.
2) To believe, to understand and to study the consequences of cosmic rotation.
3) To develop high precision cosmic gyroscopes.
4) To study galactic mean temperature and to estimate the galactic dark mass.
5) To study and to map the relativistic masses of receding galaxies with reference to their star rotation curves. This approach may help in inferring the galactic receding speeds indirectly.
6) To correlate galactic rotations and cosmic rotation.
7) To find oldest galaxies like EGSY8p7 whose age is closer to or greater than 13.8 billion years.
8) To study very high energy cosmic gravitons.
9) To study cosmic dipole magnetic moment and its related properties.

21. TO ESTIMATE THE GALACTIC DARK MASS BASED ON MOND FORMULA AND COSMIC ANGULAR VELOCITY

Considering the views of existence of Dark matter, MOND approach and considering the proposed cosmic angular velocity, we understood that, galactic dark mass increases with increasing galactic visible/ordinary matter. It can be expressed in the following way.

Let us consider a case of Newtonian approach of escape velocity for a galactic test particle of mass m and escape velocity of V_{esc}. Then,

$$\frac{1}{2}mV_{esc}^2 \cong \frac{GM_{total}m}{r} \qquad (33)$$

where M_{total} is the total mass of galaxy. Hence,

$$V_{esc}^2 \cong \frac{2GM_{total}}{r} \qquad (34)$$

$$V_{esc}^4 \cong \frac{4G^2M_{total}^2}{r^2} \qquad (35)$$

If by any reason, rotational velocity of galaxy reaches test particle's escape velocity,

$$V_{esc}^4 \cong V_{rot}^4 \cong \frac{4G^2M_{total}^2}{r^2} \qquad (36)$$

On rearranging,

$$\frac{V_{rot}^4}{2GM_{total}} \cong \frac{2GM_{total}}{r^2} \quad (37)$$

By following MOND's approach and considering our approach of current cosmic angular velocity, at present,

$$\frac{V_{rot}^4}{2GM_{total}} \cong \frac{2GM_{total}}{r^2} \cong c\omega_0 \quad (38)$$

where, $c\omega_0$ = Current possible (maximum) cosmic angular acceleration.

By ignoring the middle term $\left(\frac{2GM_{total}}{r^2}\right)$ and re-arranging relation (38), for any galaxy, at present,

$$\frac{V_{rot}^4}{2GM_{total}} \cong c\omega_0 \quad (39)$$

By defining galactic angular velocity as,

$$\omega_{gal} \cong \frac{V_{rot}^3}{2GM_{total}} \quad (40)$$

Conceptually it is possible to say that,

$$V_{rot}\omega_{gal} \cong c\omega_0 \quad (41)$$

With reference to MOND approach,

$$V_{rot} \cong \sqrt[4]{2GM_{total}c\omega_0} \quad (42)$$

Total mass of galaxy be xM_{vis} and in an empirical approach we define,

$$x \approx \left(\frac{M_{vis}}{M_{ref}}\right)^{\frac{1}{2}}(1.59) \quad (43)$$

where,
$M_{ref} \approx$ Reference mass unit
$\approx$ Mass of DDO 154 $\approx 2.60\times10^{39}$ kg.

If so,

$$\begin{aligned} \therefore V_{rot} &\cong \sqrt[4]{2GM_{total}c\omega_0} \\ &\cong \sqrt[4]{2G\,(xM_{vis})\,c\omega_0} \end{aligned} \quad (44)$$

$$\begin{aligned} &\text{Galactic Dark mass} \cong (M_{dark}) \\ &\cong \text{Galactic total mass - Galactic visible mass} \\ &\cong x(M_{vis})-(M_{vis}) \cong (x-1)(M_{vis}) \end{aligned} \quad (45)$$

$$\begin{aligned} &\text{Galactic Dark mass\%} \cong (M_{dark})\% \\ &\cong \frac{(x-1)(M_{vis})}{(M_{total})}\times100 \\ &\cong \frac{(x-1)(M_{vis})}{x(M_{vis})}\times100 \cong \frac{(x-1)}{x}\times100 \end{aligned} \quad (46)$$

Based on this procedure, we would like to appeal that,

1) Even though MOND approach was aimed for understanding galactic rotation curves without dark matter, with reference to the proposed current cosmic angular velocity and relation (44), it is possible to fit the rotation curves and thereby galactic dark mass can be inferred.
2) Staring from the lowest massive galaxy, (DDO 154) to the highest massive galaxy (NGC 2841), dark mass seems to increase from 1.6 to 25 times respectively and needs further study for the estimation of the proposed data fitting coefficient, x. See Fig. 1 and Table 1.
3) By minimizing the errors in estimating the visible mass of galaxy, accuracy can be improved. Point to be noted is that, there is no correlation between photometric mass estimations and parametric mass estimations. Similarly, in some cases, there is no correlation between MSTS mass estimations and MOND mass estimations. It needs a careful analysis [48,49,50]. See Figs. 2-4 and Table 2. In Figs. 2-4 and Table 2, with respect Metric Skew Tensor Gravity (MSTG) masses as a common reference, blue curve indicates (MSTG) rotation speeds, green curve indicates rotation speed estimated from MOND formula and red curve indicates the rotation speeds estimated with relation (44).
4) Comparing our relations (33) to (44) with MOND approach of $cH_0 \approx 1.2\times10^{-10}$ m.sec^{-2}, MOND relation can be rewritten as,

$$(V_{rot}) \cong \sqrt[4]{G\,M_{vis}\left(1.2\times10^{-10}\ \text{m.sec}^{-2}\right)}$$
$$\cong \sqrt[4]{2G\ (12.385M_{vis})\,c\omega_0} \quad (47)$$
$$\text{where, } \left(\frac{1.2\times10^{-10}\ \text{m.sec}^{-2}}{c\omega_0}\right) \cong 24.77$$

5) On comparison, percentage of dark mass in MOND model seems to be constant at ((12.385-1)/12.385)x100 = 91.93% whereas in our approach, dark matter percentage increases with increasing (visible) mass of galaxy. It is very interesting to note that, MOND's approach implicitly seems to support the cosmological estimation of 95% invisible matter and 5% visible matter. It needs further study. Based on this observation and considering the lower and upper fractions of dark mass as 0.3 and 0.95, galactic rotational speed limits can be addressed with the following relations.

$$(V_{rot})_{low} \cong \sqrt[4]{2G\left(1+\tfrac{0.3}{0.05}\right)M_{vis}c\omega_0}$$
$$\cong \sqrt[4]{2G\left(7M_{vis}\right)c\omega_0} \quad (48)$$
$$\text{where } \left(1+\tfrac{0.3}{0.05}\right) \cong 1+6=7$$

$$(V_{rot})_{upper} \cong \sqrt[4]{2G\left(1+\tfrac{0.95}{0.05}\right)M_{vis}c\omega_0}$$
$$\cong \sqrt[4]{2G\left(20M_{vis}\right)c\omega_0} \quad (49)$$
$$\text{where } \left(1+\tfrac{0.95}{0.05}\right) \cong 1+19=20$$

$$(V_{rot})_{mean} \cong \sqrt[4]{2G\left(13.5M_{vis}\right)c\omega_0} \quad (50)$$

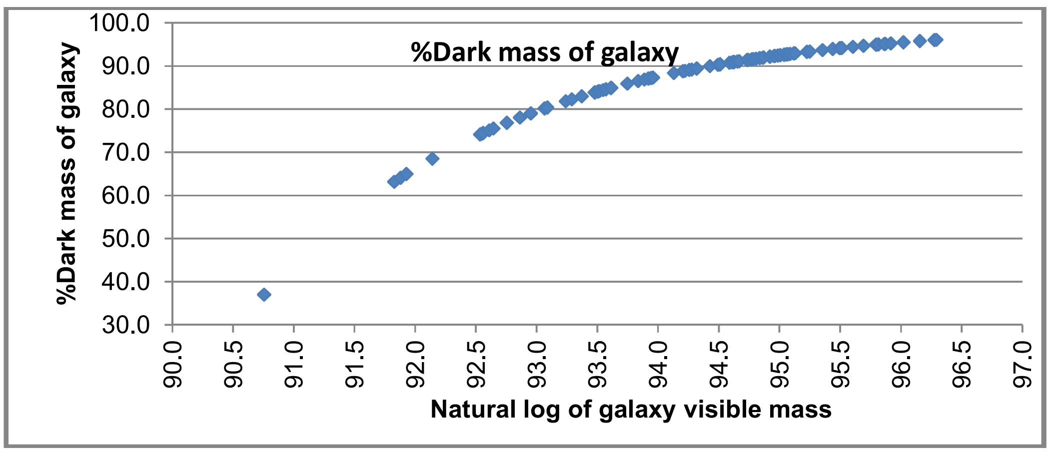

Fig. 1. Estimated galactic dark mass parentage

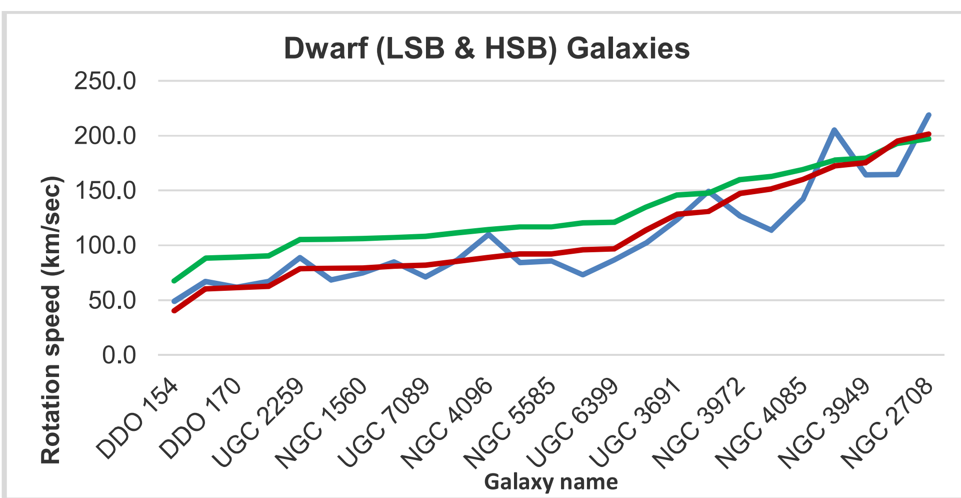

Fig. 2. Galactic rotation speeds of Dwarf galaxies

Table 1. Galactic dark mass factor estimated by fitting with galactic rotation curves and MOND approach

Galaxy Name	Galaxy visible mass (kg)	Natural log of Galaxy visible mass	Total mass factor (x)	Dark mass factor $(x-1)$	%Dark mass $\frac{(x-1)}{x}\times 100$
DDO 154	2.6E+39	90.76	1.59	0.59	37.01
F583-4	7.6E+39	91.83	2.71	1.71	63.16
DDO 170	8E+39	91.88	2.78	1.78	64.09
DDO 168	8.4E+39	91.93	2.85	1.85	64.96
NGC 3034	1.04E+40	92.14	3.18	2.18	68.51
UGC 2259	1.54E+40	92.54	3.86	2.86	74.12
NGC 3109	1.56E+40	92.55	3.89	2.89	74.29
NGC 1560	1.58E+40	92.56	3.91	2.91	74.45
UGC 6446	1.66E+40	92.61	4.01	3.01	75.07
UGC 7089	1.72E+40	92.65	4.08	3.08	75.51
UGC 6923	1.92E+40	92.76	4.31	3.31	76.82
NGC 4096	2.14E+40	92.86	4.55	3.55	78.04
NGC 55	2.34E+40	92.95	4.76	3.76	79.00
NGC 5585	2.34E+40	92.95	4.76	3.76	79.00
UGC 6818	2.62E+40	93.07	5.04	4.04	80.16
UGC 6399	2.68E+40	93.09	5.10	4.10	80.38
F583-1	3.12E+40	93.24	5.50	4.50	81.82
NGC 1003	3.28E+40	93.29	5.64	4.64	82.27
NGC 598	3.56E+40	93.37	5.87	4.87	82.98
NGC 4448	3.96E+40	93.48	6.20	5.20	83.86
NGC 6503	3.96E+40	93.48	6.20	5.20	83.86
NGC 300	4.06E+40	93.50	6.27	5.27	84.06
NGC 4183	4.08E+40	93.51	6.29	5.29	84.10
UGC 6917	4.12E+40	93.52	6.32	5.32	84.18
UGC 6983	4.24E+40	93.55	6.41	5.41	84.40
UGC 6930	4.34E+40	93.57	6.49	5.49	84.58
F563-1	4.52E+40	93.61	6.62	5.62	84.89
NGC 247	4.54E+40	93.62	6.63	5.63	84.93
NGC 3769	5.18E+40	93.75	7.09	6.09	85.89
UGC 3691	5.66E+40	93.84	7.41	6.41	86.50
NGC 4062	5.96E+40	93.89	7.60	6.60	86.84
F568-3	6.16E+40	93.92	7.73	6.73	87.06
NGC 4303	6.16E+40	93.92	7.73	6.73	87.06
NGC 4736	6.3E+40	93.94	7.81	6.81	87.20
NGC 660	6.4E+40	93.96	7.88	6.88	87.30
NGC 2403	7.6E+40	94.13	8.58	7.58	88.35
NGC 3972	8.18E+40	94.21	8.90	7.90	88.77
NGC 1808	8.2E+40	94.21	8.92	7.92	88.78
NGC 3495	8.32E+40	94.22	8.98	7.98	88.87
NGC 4138	8.62E+40	94.26	9.14	8.14	89.06
NGC 4389	8.8E+40	94.28	9.24	8.24	89.17
NGC 4945	9.16E+40	94.32	9.42	8.42	89.39
NGC 5907	9.18E+40	94.32	9.43	8.43	89.40
NGC 4085	1.022E+41	94.43	9.95	8.95	89.95
F571-8	1.092E+41	94.49	10.29	9.29	90.28
NGC 3198	1.11E+41	94.51	10.37	9.37	90.36
NGC 4527	1.11E+41	94.51	10.37	9.37	90.36
NGC 4010	1.112E+41	94.51	10.38	9.38	90.37
NGC 4013	1.202E+41	94.59	10.79	9.79	90.74

Galaxy Name	Galaxy visible mass (kg)	Natural log of Galaxy visible mass	Total mass factor (x)	Dark mass factor $(x-1)$	%Dark mass $\frac{(x-1)}{x}\times 100$
NGC 4631	1.23E+41	94.61	10.92	9.92	90.84
NGC 5236	1.232E+41	94.61	10.93	9.93	90.85
NGC 6951	1.244E+41	94.62	10.98	9.98	90.89
NGC 4569	1.246E+41	94.63	10.99	9.99	90.90
NGC 3917	1.25E+41	94.63	11.01	10.01	90.92
UGC 6973	1.282E+41	94.65	11.15	10.15	91.03
NGC 3949	1.302E+41	94.67	11.23	10.23	91.10
NGC 253	1.388E+41	94.73	11.60	10.60	91.38
NGC 3031	1.39E+41	94.74	11.61	10.61	91.39
NGC 3379	1.398E+41	94.74	11.64	10.64	91.41
NGC 4051	1.442E+41	94.77	11.82	10.82	91.54
NGC 4258	1.458E+41	94.78	11.89	10.89	91.59
NGC 5194	1.458E+41	94.78	11.89	10.89	91.59
NGC 891	1.494E+41	94.81	12.03	11.03	91.69
NGC 3893	1.54E+41	94.84	12.22	11.22	91.82
NGC 3521	1.578E+41	94.86	12.37	11.37	91.91
IC 342	1.59E+41	94.87	12.42	11.42	91.95
NGC 5055	1.676E+41	94.92	12.75	11.75	92.15
NGC 3877	1.73E+41	94.95	12.95	11.95	92.28
NGC 3079	1.746E+41	94.96	13.01	12.01	92.31
NGC 6946	1.79E+41	94.99	13.17	12.17	92.41
Milky Way	1.824E+41	95.01	13.30	12.30	92.48
NGC 3628	1.826E+41	95.01	13.30	12.30	92.48
NGC 1068	1.884E+41	95.04	13.51	12.51	92.60
NGC 2708	1.886E+41	95.04	13.52	12.52	92.60
NGC 3726	1.92E+41	95.06	13.64	12.64	92.67
NGC 2903	1.932E+41	95.06	13.69	12.69	92.69
NGC 4088	1.948E+41	95.07	13.74	12.74	92.72
NGC 5033	1.98E+41	95.09	13.85	12.85	92.78
NGC 5457	2.04E+41	95.12	14.06	13.06	92.89
NGC 4100	2.06E+41	95.13	14.13	13.13	92.92
UGC 6614	2.272E+41	95.23	14.84	13.84	93.26
NGC 4157	2.328E+41	95.25	15.02	14.02	93.34
NGC 4217	2.584E+41	95.36	15.83	14.83	93.68
NGC 2590	2.81E+41	95.44	16.50	15.50	93.94
NGC 3672	2.972E+41	95.50	16.97	15.97	94.11
NGC 1365	2.992E+41	95.50	17.03	16.03	94.13
NGC 2998	3.026E+41	95.51	17.13	16.13	94.16
NGC 1417	3.32E+41	95.61	17.94	16.94	94.43
NGC 4565	3.622E+41	95.69	18.74	17.74	94.66
NGC 801	4.014E+41	95.80	19.73	18.73	94.93
NGC 224	4.038E+41	95.80	19.79	18.79	94.95
NGC 3953	4.094E+41	95.82	19.92	18.92	94.98
NGC 7331	4.294E+41	95.86	20.40	19.40	95.10
NGC 4321	4.334E+41	95.87	20.50	19.50	95.12
NGC 1097	4.536E+41	95.92	20.97	19.97	95.23
NGC 3992	5.032E+41	96.02	22.09	21.09	95.47
NGC 5533	5.762E+41	96.16	23.63	22.63	95.77
NGC 6674	6.496E+41	96.28	25.09	24.09	96.02
NGC 2841	6.608E+41	96.29	25.31	24.31	96.05

Table 2. Galactic rotation speeds of Dwarf, LSB and HSB galaxies

Galaxy Name	Galaxy visible mass (kg)	Total mass factor x	Rotation speed from MSTG estimations (km/sec)	Rotation speed from MOND estimations (km/sec) Relation(47)	Estimated rotation speed (km/sec) Relation(44)	%Error w.r.t MSTG	%Error w.r.t MOND
			Dwarf (LSB & HSB) Galaxies				
DDO 154	2.60E+39	1.59	48.9	67.5	40.4	17.4	40.2
F583-4	7.6E+39	2.71	67.2	88.3	60.4	10.1	31.6
DDO 170	8E+39	2.78	61.9	89.4	61.6	0.5	31.1
DDO 168	8.4E+39	2.85	67.1	90.5	62.7	6.5	30.7
UGC 2259	1.54E+40	3.86	88.8	105.4	78.7	11.3	25.3
NGC 3109	1.56E+40	3.89	68.6	105.7	79.1	-15.3	25.1
NGC 1560	1.58E+40	3.91	74.9	106.0	79.5	-6.1	25.0
UGC 6446	1.66E+40	4.01	85.1	107.3	81.0	4.8	24.6
UGC 7089	1.72E+40	4.08	71.1	108.3	82.1	-15.4	24.2
UGC 6923	1.92E+40	4.31	86.5	111.3	85.5	1.1	23.2
NGC 4096	2.14E+40	4.55	110.1	114.4	89.1	19.1	22.1
NGC 55	2.34E+40	4.76	84.4	117.0	92.1	-9.1	21.3
NGC 5585	2.34E+40	4.76	85.7	117.0	92.1	-7.5	21.3
UGC 6818	2.62E+40	5.04	73.1	120.3	96.1	-31.5	20.1
UGC 6399	2.68E+40	5.10	86.7	121.0	96.9	-11.8	19.9
UGC 6917	4.12E+40	6.32	102.1	134.7	113.9	-11.5	15.5
UGC 3691	5.66E+40	7.41	123.5	145.9	128.3	-3.9	12.1
NGC 4062	5.96E+40	7.60	149.4	147.8	130.8	12.5	11.5
NGC 3972	8.18E+40	8.90	126.8	159.9	147.3	-16.1	7.9
NGC 4389	8.8E+40	9.24	113.9	162.9	151.4	-32.9	7.1
NGC 4085	1.022E+41	9.95	142.0	169.1	160.1	-12.7	5.3
NGC 4569	1.246E+41	10.99	205.0	177.7	172.5	15.9	2.9
NGC 3949	1.302E+41	11.23	164.5	179.6	175.3	-6.6	2.4
NGC 3877	1.73E+41	12.95	164.8	192.9	195.0	-18.3	-1.1
NGC 2708	1.886E+41	13.52	218.7	197.1	201.5	7.9	-2.2
			LSB GALAXIES				
UGC 6446	1.66E+40	4.01	85.1	107.3	81.0	4.8	24.6
F583-1	3.12E+40	5.50	93.2	125.7	102.6	-10.1	18.4
NGC 1003	3.28E+40	5.64	121.5	127.3	104.5	14.0	17.9
NGC 598	3.56E+40	5.87	110.9	129.9	107.8	2.8	17.0
NGC 4183	4.08E+40	6.29	111.3	134.4	113.5	-1.9	15.6
UGC 6983	4.24E+40	6.41	111.5	135.7	115.1	-3.2	15.2
UGC 6930	4.34E+40	6.49	109.5	136.5	116.1	-6.0	14.9
F563-1	4.52E+40	6.62	110.4	137.9	117.9	-6.8	14.5
NGC 247	4.54E+40	6.63	109.4	138.1	118.1	-8.0	14.5
F568-3	6.16E+40	7.73	110.9	149.0	132.4	-19.4	11.1
NGC 3495	8.32E+40	8.98	142.1	160.6	148.2	-4.3	7.7
F571-8	1.092E+41	10.29	141.2	171.9	164.1	-16.2	4.5
NGC 4010	1.112E+41	10.38	136.2	172.7	165.2	-21.3	4.3
NGC 3917	1.25E+41	11.01	142.8	177.8	172.7	-20.9	2.9
UGC 6614	2.272E+41	14.84	192.3	206.5	216.0	-12.3	-4.6
NGC 3672	2.972E+41	16.97	215.2	220.8	238.9	-11.0	-8.2
NGC 1417	3.32E+41	17.94	238.2	227.0	249.0	-4.6	-9.7
			HSB GALAXIES				
NGC 3034	1.04E+40	3.18	85.0	95.5	68.0	20.1	28.8
NGC 4448	3.96E+40	6.20	127.8	133.4	112.2	12.2	15.9
NGC 6503	3.96E+40	6.20	117.4	133.4	112.2	4.4	15.9
NGC 300	4.06E+40	6.27	101.7	134.2	113.3	-11.4	15.6

Galaxy Name	Galaxy visible mass (kg)	Total mass factor x	Rotation speed from MSTG estimations (km/sec)	Rotation speed from MOND estimations (km/sec) Relation(47)	Estimated rotation speed (km/sec) Relation(44)	%Error w.r.t MSTG	%Error w.r.t MOND
NGC 3769	5.18E+40	7.09	121.7	142.7	124.1	-2.0	13.0
NGC 4303	6.16E+40	7.73	143.8	149.0	132.4	7.9	11.1
NGC 4736	6.3E+40	7.81	146.8	149.8	133.5	9.0	10.9
NGC 660	6.4E+40	7.88	146.6	150.4	134.3	8.4	10.7
NGC 2403	7.6E+40	8.58	133.7	157.0	143.3	-7.2	8.8
NGC 1808	8.2E+40	8.92	160.6	160.0	147.4	8.2	7.9
NGC 4138	8.62E+40	9.14	160.7	162.1	150.2	6.5	7.3
NGC 4945	9.16E+40	9.42	165.1	164.5	153.7	6.9	6.6
NGC 5907	9.18E+40	9.43	169.3	164.6	153.8	9.2	6.6
NGC 3198	1.11E+41	10.37	152.1	172.6	165.1	-8.6	4.3
NGC 4527	1.11E+41	10.37	174.3	172.6	165.1	5.3	4.3
NGC 4013	1.202E+41	10.79	181.1	176.1	170.1	6.1	3.4
NGC 4631	1.23E+41	10.92	171.4	177.1	171.6	-0.1	3.1
NGC 5236	1.232E+41	10.93	175.5	177.2	171.7	2.2	3.1
NGC 6951	1.244E+41	10.98	185.8	177.6	172.3	7.2	3.0
UGC 6973	1.282E+41	11.15	172.5	179.0	174.3	-1.0	2.6
NGC 253	1.388E+41	11.60	188.0	182.5	179.6	4.5	1.6
NGC 3031	1.39E+41	11.61	191.8	182.6	179.7	6.3	1.6
NGC 3379	1.398E+41	11.64	196.7	182.9	180.1	8.5	1.5
NGC 4051	1.442E+41	11.82	161.7	184.3	182.2	-12.7	1.2
NGC 4258	1.458E+41	11.89	191.9	184.8	182.9	4.7	1.0
NGC 5194	1.458E+41	11.89	196.6	184.8	182.9	7.0	1.0
NGC 891	1.494E+41	12.03	194.9	185.9	184.6	5.3	0.7
NGC 3893	1.54E+41	12.22	179.3	187.3	186.7	-4.1	0.3
NGC 3521	1.578E+41	12.37	198.7	188.5	188.4	5.2	0.0
IC 342	1.59E+41	12.42	188.3	188.9	189.0	-0.4	-0.1
NGC 5055	1.676E+41	12.75	196.9	191.4	192.7	2.1	-0.7
NGC 3079	1.746E+41	13.01	207.1	193.3	195.7	5.5	-1.2
NGC 6946	1.79E+41	13.17	161.2	194.5	197.5	-22.5	-1.6
Milky Way	1.824E+41	13.30	204.8	195.4	198.9	2.9	-1.8
NGC 3628	1.826E+41	13.30	202.3	195.5	199.0	1.6	-1.8
NGC 1068	1.884E+41	13.51	205.9	197.0	201.4	2.2	-2.2
NGC 3726	1.92E+41	13.64	158.4	198.0	202.8	-28.0	-2.4
NGC 2903	1.932E+41	13.69	195.9	198.3	203.3	-3.8	-2.5
NGC 4088	1.948E+41	13.74	172.4	198.7	203.9	-18.3	-2.6
NGC 5033	1.98E+41	13.85	210.2	199.5	205.2	2.4	-2.8
NGC 5457	2.04E+41	14.06	206.5	201.0	207.5	-0.5	-3.2
NGC 4100	2.06E+41	14.13	180.2	201.5	208.2	-15.6	-3.3
NGC 4157	2.328E+41	15.02	188.5	207.7	218.0	-15.7	-4.9
NGC 4217	2.584E+41	15.83	189.7	213.2	226.7	-19.5	-6.3
NGC 2590	2.81E+41	16.50	241.0	217.7	233.9	2.9	-7.4
NGC 1365	2.992E+41	17.03	242.6	221.2	239.5	1.3	-8.3
NGC 2998	3.026E+41	17.13	216.7	221.8	240.5	-11.0	-8.4
NGC 4565	3.622E+41	18.74	251.2	232.0	257.3	-2.4	-10.9
NGC 801	4.014E+41	19.73	240.3	238.0	267.4	-11.3	-12.3
NGC 224	4.038E+41	19.79	259.6	238.4	268.0	-3.2	-12.4
NGC 3953	4.094E+41	19.92	225.5	239.2	269.4	-19.5	-12.6
NGC 7331	4.294E+41	20.40	248.9	242.1	274.3	-10.2	-13.3
NGC 4321	4.334E+41	20.50	260.2	242.7	275.2	-5.8	-13.4
NGC 1097	4.536E+41	20.97	290.1	245.4	280.0	3.5	-14.1
NGC 3992	5.032E+41	22.09	260.9	251.9	291.1	-11.6	-15.6

Galaxy Name	Galaxy visible mass (kg)	Total mass factor x	Rotation speed from MSTG estimations (km/sec)	Rotation speed from MOND estimations (km/sec) Relation(47)	Estimated rotation speed (km/sec) Relation(44)	%Error w.r.t MSTG	%Error w.r.t MOND
NGC 5533	5.762E+41	23.63	293.2	260.6	306.2	-4.4	-17.5
NGC 6674	6.496E+41	25.09	277.7	268.5	320.3	-15.3	-19.3
NGC 2841	6.608E+41	25.31	308.3	269.6	322.4	-4.6	-19.6

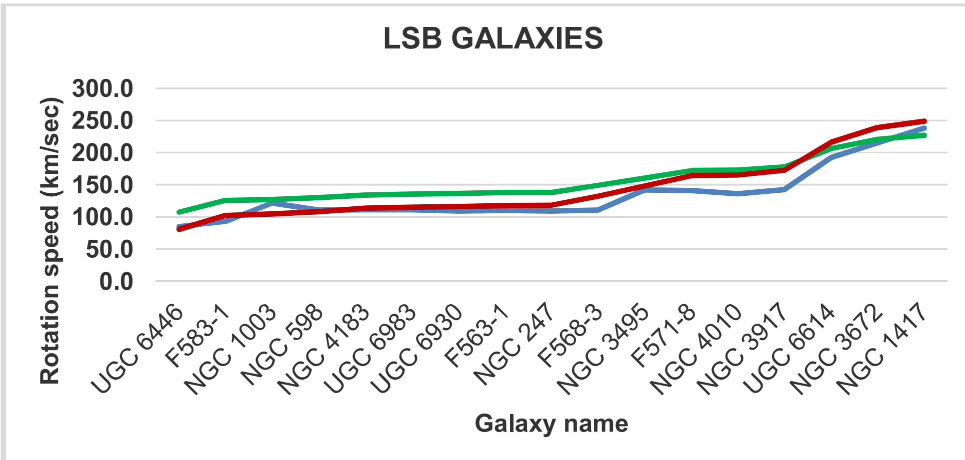

Fig. 3. Galactic rotation speeds of LSB galaxies

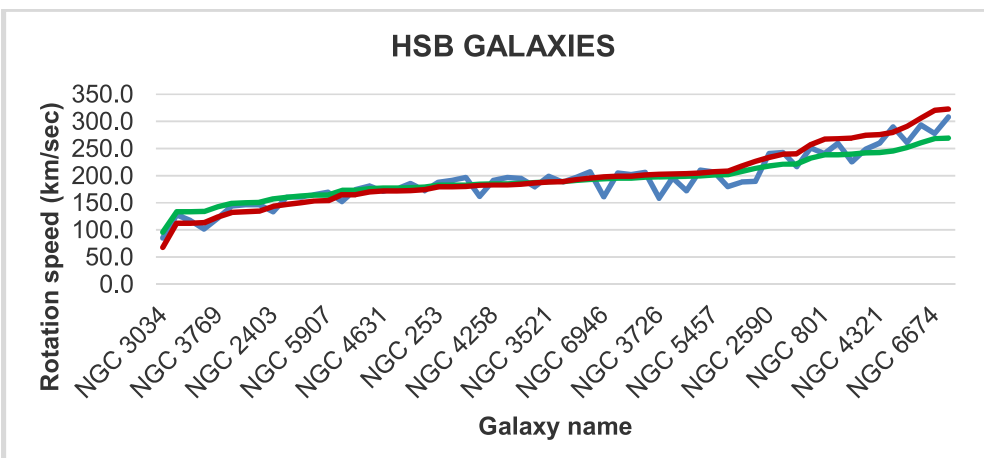

Fig. 4. Galactic rotation speeds of HSB galaxies

22. CONCLUSION

Considering the points and relations proposed in sections (2) to (21), our model can be recommended for further research. We would like to emphasize the point that, 'space' and 'matter' are inseparable cosmic entities and like matter, space cannot travel faster than speed of light. Flatness problem can be understood with Schwarzschild radius of the current universe. Considering light speed expansion, inflation and dark energy concepts can be relinquished. Based on relations (3, 5, 11 and 12), Hubble parameter can be estimated independent of galactic distances and their red shifts.

Even though, cosmic horizon is assumed to be expanding at light speed, based on relations (27 and 32), it seems possible to have internal acceleration below the cosmic horizon and seems to be a consequence of Hubble's law for increasing time periods. Estimated cosmic radius seems to be 140.56 times the Hubble radius, angular velocity seems to be 140.56 times less than the Hubble parameter and it seems essential to develop new techniques for measuring cosmic radius and angular velocity.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Friedmann A. On the curvature of space. General Relativity and Gravitation. 1999;31(12):1991-2000.
2. Hawking SW. A brief history of time. Bantam Dell Publishing Group; 1988.
3. Seshavatharam UVS. Physics of rotating and expanding black hole universe. Progress in Physics. 2010;4:7-14.
4. Seshavatharam UVS. The Primordial cosmic black hole and the cosmic axis of evil. International Journal of Astronomy. 2012;1(2):20-37.
5. Seshavatharam UVS, Lakshminarayana S. Applications of hubble volume in atomic physics, nuclear physics, particle physics, quantum physics and cosmic physics. J. Nucl. Phy. Mat. Sci. Rad. A. 2013;1(1):45-60.
6. Seshavatharam UVS, Lakshminarayana S. Friedman cosmology: Reconsideration and new results. International Journal of Astronomy, Astrophysics and Space Science. 2014;1(2):16-26.
7. Seshavatharam UVS, Lakshminarayana S. On the evolving black holes and black hole cosmology-scale independent quantum gravity approach. Frontiers of Astronomy, Astrophysics and Cosmology. 2014;1(1):1-15.
8. Seshavatharam UVS, Lakshminarayana S. Black hole cosmology with propelling lambda term & hindu cosmic age. Prespacetime Journal. 2015;6(9):850-874.
9. Seshavatharam UVS, Lakshminarayana S. Role of Mach's principle and quantum gravity in understanding cosmic evolution and cosmic red-shift. Frontiers of Astronomy, Astrophysics and Cosmology. 2015;1(1):24-30.
10. Tatum ET, Seshavatharam UVS, Lakshminarayana S. The basics of flat space cosmology. International Journal of Astronomy and Astrophysics. 2015;5:116-124.
11. Seshavatharam UVS, Lakshminarayana S. Primordial hot evolving black holes and the evolved primordial cold black hole universe. Frontiers of Astronomy, Astrophysics and Cosmology. 2015;1(1):16-23.
12. Seshavatharam UVS, Lakshminarayana S. Cosmologically strengthening hydrogen atom in black hole universe. J. Nucl. Phy. Mat. Sci. Rad. A. 2016;3(2):265–278.
13. Seshavatharam UVS, Lakshminarayana S. On the possible role of continuous light speed expansion in black hole & Gravastar cosmology. Prespacetime Journal. 2016;7(3):584-600.
14. Seshavatharam UVS, Lakshminarayana S. A first step in evolving quantum cosmology. Journal of Physics: Conf. Series. 2019;1251:012045.
15. Seshavatharam UVS, Lakshminarayana S. An outline picture of a growing and rotating planck universe with emerging dark foam. Asian Journal of Research and Reviews in Physics. 2019;2(2):1-13.
16. Seshavatharam UVS, Lakshminarayana S. A practical model of godel–Planck–Hubble–Birch universe. Athens Journal of Sciences. 2019;6(3):211-230.

17. Bojowald M. Quantum cosmology: A review. Rep. Prog. Phys. 2015;78:023901.
18. Nielsen JT, Guffanti A, Sarkar S. Marginal evidence for cosmic acceleration from type Ia supernovae. Scientific Reports. 2016;6:35596.
19. Wei JJ, Wu XF, Melia F, Maier RS. Comparative analysis of the Supernova Legacy Survey sample with ΛCDM and the Rh=ct Universe. The Astronomical Journal. 2015;149:102.
20. Melia F, Fatuzzo M. The epoch of reionization in the R_h=ct universe. Monthly Notices of Royal Astronomical Society. 2016;456(4):3422-3431.
21. Arved Sapar. A perpetual mass-generating Planckian universe. Proceedings of the Estonian Academy of Sciences. 2019;68(1):1-12.
22. Netchitailo VS. World-universe model-alternative to big bang model. Journal of High Energy Physics, Gravitation and Cosmology. 2020;6:133-158.
23. Mitra Abhas. Why the big bang model cannot describe the observed universe having pressure and radiation. Journal of Modern Physics. 2011;2:1436-42.
24. Steinhardt PJ, Abraham Loeb. Inflationary schism. Physics Letters B. 2014;736:142.
25. Poplawski NJ. The energy and momentum of the universe. Class. Quantum Grav. 2014;31:065005.
26. Carr BJ. Primordial black holes as a probe of cosmology and high energy physics. Physics Lect. Notes Phys. 2003;631:301-321.
27. Worsley Andrew. Advances in black hole physics and dark matter modelling of the galactic halo. Applied Physics Research. 2012;4(1):128-137.
28. Seshavatharam UVS, Lakshminarayana S. Nuclear mass density based high temperature stable black holes. Proceedings of the DAE Symp. on Nucl. Phys. 2014;59:804-805.
29. Birch P. Is the universe rotating? Nature. 1982;298:451-454.
30. Obukhov YN. On physical foundations and observational effects of cosmic rotation colloquium on cosmic rotation. In M Scherfner, T Chrobok, M. Shefaat (Eds). Colloquium on Cosmic Rotation, 23. Berlin: Wissenschaft und Technik Verlag; 2000.
31. Godlowski W. Global and local effects of rotation: Observational aspects. International Journal of Modern Physics. 2011;20(9):1643-1673.
32. Longo MJ. Detection of a dipole in the handedness of spiral galaxies with redshifts z ~ 0.04. Physics Letters B. 2011;699(4):224-229.
33. Chechin LM. Does the cosmological principle exist in the rotating universe? Gravitation and Cosmology. 2017;23(4):305-310.
34. Whittaker ET. Spin in the universe. Yearbook of Royal Society. Edinburgh. 1945;513.
35. Timkov Valery, Timkov SV. Rotating space of the universe as a source of dark energy and dark matter. The International Scientific-Technical Magazine: Measuring and Computing Devices in Technological Processes. 2015;3:200-204.
36. Lior Shamir. Multipole alignment in the large-scale distribution of spin direction of spiral galaxies. arXiv. 2004;02963v3.
37. Levkov DG, Panin AG, Tkachev II. Gravitational Bose-Einstein condensation in the kinetic regime. Physical Review Letters. 2018;121(15):151301.
38. Tatum ET. Dark matter as cold atomic hydrogen in its lower ground state. Book Chapter; 2020. DOI:http://dx.doi.org/10.5772/intechopen.91690
39. Bernard J. Wood, Duane J. Smythe, Thomas Harrison. The condensation temperatures of the elements: A reappraisal. American Mineralogist. 2019;104:844–856.
40. Planck Collaboration: Planck. Results. XIII. Cosmological Parameters; 2015.
41. Hubble EP. A relation between distance and radial velocity among extra-galactic nebulae. Proceedings of the National Academy of Sciences. 1962;15:168-173.
42. Massimo Giovannini. Primordial backgrounds of relic gravitons. Prog. Part. Nucl. Phys. 2020;103774.
43. Aluri PK, Jain P. Large scale anisotropy due to pre-inflationary phase of cosmic evolution. Modern. Physical Letters A. 2012;27(4):1250014.
44. Perlmutter S, et al. Measurements of Ω and Λ from 42 high-redshift supernovae. The Astrophysical Journal. 1999;517(2):565.
45. Riess AG, et al. Observational evidence from supernovae for an accelerating universe and a cosmological constant. The Astronomical Journal. 1998;116(3):1009-1038.

46. Wang D, Meng XH. No evidence for dynamical dark energy in two models. Physical Review D. 2017;96(10): 103516.
47. Gamow G. The origin of elements and the separation of galaxies. Physical Review. 1948;74(4):505.
48. Brownstein JR, Moffat JW. Galaxy rotation curves without non-baryonic dark matter. The Astrophysical Journal. 2006;636:721–741.
49. Milgrom M. A modification of the Newtonian dynamics as a possible alternative to the hidden mass hypothesis. Astrophysical Journal. Part 1. 1983;270:365-370.
50. Seshavatharam UVS, Lakshminarayana S. Toy model of evolving and spinning quantum cosmology – A review. International Journal of Astronomy, Astrophysics and Space Science. 2018;5(1):1-13.

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