physical sciences forum

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Proceeding Paper

A Rotating Model of a Light Speed Expanding Hubble-Hawking Universe †

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† Presented at the 2nd Electronic Conference on Universe, 16 February–2 March 2023; Available online: https://ecu2023.sciforum.net/.

Abstract: Based on light speed expansion, a modified red shift formula, a scaled Hawking's black hole temperature formula, the super gravity of galactic baryon matter and baby Planck ball, in our recent publications we have clearly established a novel model of quantum cosmology. In this contribution, we appeal for the need of reviewing the basics of Lambda cosmology in the context of cosmic quantum spin. We would like to emphasize the point that spin is a basic property of quantum mechanics, and one who is interested in developing quantum models of cosmology must think about cosmic rotation. It may also be noted that, without a radial in-flow of matter in all directions towards one specific point, one cannot expect a big crunch and without a big crunch one cannot expect a big bang. Really, if there was a "big bang" in the past, with reference to the formation of the big bang as predicted by General Theory of Relativity (GTR) and with reference to the cosmic rate of expansion that might have taken place simultaneously in all directions at a "naturally selected rate" about the point of big bang, the "point" of the big bang can be considered as the characteristic reference point of cosmic expansion in all directions. Thinking in this way, either the point of big bang or baby Planck ball can be considered as a possible centre of cosmic evolution.

Keywords: light speed expansion; Planck ball; Hubble–Hawking universe; quantum cosmology; cosmic rotation; limiting magnitudes of current cosmic angular velocity and rotation speed

Citation: Seshavatharam, U.V.S.; Lakshminarayana, S. A Rotating Model of a Light Speed Expanding Hubble-Hawking Universe. *Phys. Sci. Forum* **2023**, *7*, 43. https://doi.org/10.3390/ECU2023-14065

Academic Editor: Douglas Singleton

Published: 18 February 2023

1. Introduction

Mainstream cosmologists strongly believe that the current expanding universe has no centre and no rotation [1]. Scientists who strongly believe in cosmic rotation suggest that the current magnitude of cosmic angular velocity is very small in magnitude and is beyond the scope of observations [2–4]. Unfortunately, applications of cosmic angular velocity are also lagging in acquiring a strong foundation in constructing workable models of rotating cosmologies. In this context, we emphasize the following facts.

(1) From a quantum cosmology [5] point of view, in a theoretical approach, spin or rotation can be given a chance in developing quantum models of cosmology.
(2) The current model of Lambda cosmology [6] is badly failing in incorporating quantum gravity concepts.
(3) Very few cosmologists are working on quantum cosmology models.
(4) Clearly speaking, no cosmologist has a clear vision of quantum models of cosmology.

Keeping these points in view, we can confidently say that models of cosmology without cosmic rotation cannot be considered as standard models of cosmology. In support of this statement, we propose the following logical points.

(1) An important point to be noted is that to have rotation, the universe should have a closed or positive curvature. Two recent technical papers [7,8] published in two very

high impact journals seem to support a closed universe. In this context, we would like to recall the views of Di Valentino, Melchiorri and Silk [7]. According to their analysis and interpretation, the observed enhanced lensing amplitude of cosmic microwave background radiation can be explained with a positive curvature of the universe at a 99% confidence level. Proceeding further, according to Will Handley [8], in light of the inconsistency between Planck, CMB lensing and BAO data in the context of curved universes, cosmologists can no longer conclude that observations support a flat universe.

(2) Hubble's observations [9] can also be studied with rotating and expanding models of cosmology.

(3) In a rotating frame, quantitatively Hubble's law resembles a cosmic light speed rotation concept.

(4) The general theory of relativity is no way against cosmic rotation [10].

(5) Without a radial in-flow of matter in all directions towards one specific point, one cannot expect a big crunch, and without a big crunch one cannot expect a big bang. Really, if there was a "big bang" in the past, with reference to the formation of the big bang as predicted by GTR and with reference to the cosmic rate of expansion that might have taken place simultaneously in all directions at a "naturally selected rate" about the point of the big bang, the "point" of the big bang can be considered as the characteristic reference point of cosmic expansion in all directions. Thinking in this way, either the point of the big bang or baby Planck ball can be considered as a possible centre of cosmic evolution.

(6) If the observed universe is assumed to be associated with only one big bang, then the 'point of big bang' can certainly be considered as the characteristic reference point of cosmic evolution in all directions.

(7) If the currently believed cosmic big bang is really a 'singularity', it seems more logical to depend on the Planck scale rather than the big bang. It may be noted that, in general, gravitational singularities are not clear about "Where, When and How" as essential points that are believed to be the basics of developing any workable physical model.

(8) Modern cosmological observations are providing strong evidence for the existence of mysterious rotational features of large cosmic filaments [11].

(9) The current Hubble's constant can be considered as a limiting magnitude of current cosmic angular velocity. Similarly, light speed can be considered as a limiting magnitude of current cosmic rotation speed.

(10) If it is really important to understand the radical nature of current cosmic acceleration [12], based on light speed expansion, it can be understood as follows. As time is passing, to sustain continuous light speed expansion, galaxies maintain higher acceleration near to the cosmic centre and lower acceleration near to the cosmic boundary. Clearly speaking, being higher in magnitude near to the cosmic centre, galactic acceleration gradually disappears at the cosmic boundary. In a mathematical form, for the current case, it can be expressed as $(a_r)_0 = [c - (v_r)_0]H_0$ where r, (v_r) and (a_r) represent galactic distance, receding speed and acceleration from the cosmic centre, respectively.

2. Light Speed Expanding Hubble–Hawking Universe

Based on light speed expansion, modified red shift formula, scaled Hawking's black hole temperature formula, super gravity of galactic baryon matter and baby Planck ball, in our recent publications [13–22] we have clearly established a novel model of quantum cosmology. Readers are encouraged to refer to our recently published paper for more information [21].

2.1. Need for Considering Light Speed Expansion

Based on recent papers [4,7,8,11] published in high reputation journals, mainstream cosmologists are forced to review dark energy and dark matter in a different way. Now, it is very clear that there is a disagreement between mainstream cosmologists and other researchers. Cosmological observations are not straightforward. For the same data, different interpretations are coming into the picture with a great diversity. Right now, it is not at all possible to prove the exact nature of cosmic expansion, whether it is accelerating or decelerating. In this very ambiguous situation, it seems interesting to take the help of 'light speed' as a tool. There is a possibility for considering light speed radial expansion as well as light speed rotation. We would like to emphasize that:

(1) All cosmological observations and physical studies and research are being accomplished with 'light speed' only;
(2) References [23–25] pertaining to 740 super novae data clearly suggest that the universe is expanding at a constant rate against currently believed cosmic acceleration;
(3) So far, no single experiment or no single observation has confirmed super luminal physical results;
(4) It is well confirmed that gravitons are moving with the speed of light;
(5) In one sentence, 'without light', there is no cosmology and there is no physics.

2.2. Strange Coincidences and Their Impact on Lambda Cosmology

In this section, we propose important coincidences and data fits. We assure the reader that these coincidences will certainly bring a change in their way of thinking among current and future generation cosmologists on the basic views of Lambda cosmology.

(1) Theoretically, distance travelled by a photon in 13.8 billion years of cosmic age is 1.3×10^{26} m and is equal to the currently believed Hubble radius $R_0 \cong (c/H_0)$. Based on this coincidence, and considering Planck scale as the origin, it seems logical to consider the cosmic time-distance scale as $R_t - R_{pl} \cong ct$ where R_{pl}, R_t represent Planck scale cosmic radius and radius at any time t.
(2) Considering the product of currently believed cosmic critical density, $\rho_0 \cong \left(3H_0^2/8\pi G\right)$, and Hubble volume, $V_0 \cong (4\pi/3)(c/H_0)^3$, it is possible to show that $M_0 \cong \left(c^3/2GH_0\right)$. Based on this relation, from the beginning of Planck scale, cosmic radius can be expressed as $R_t \cong (c/H_t) \cong 2GM_t/c^2$.
(3) Following Hawking's black hole temperature formula [26], the current cosmic temperature can be expressed as $T_0 \cong \frac{\hbar c^3}{8\pi k_B G\sqrt{M_{pl}M_0}}$ or $T_0 \cong \frac{\hbar\sqrt{H_0 H_{pl}}}{4\pi k_B}$ where $T_0 \cong 2.72548$ K and $H_0 \cong 66.89$ km/ sec /Mpc. Based on this relation, from the beginning of Planck scale, cosmic temperature can be expressed as $T_t \cong \frac{\hbar c^3}{8\pi k_B G\sqrt{M_{pl}M_t}} \cong \frac{\hbar\sqrt{H_t H_{pl}}}{4\pi k_B}$ where $M_t \cong \frac{c^3}{2GH_t}, M_{pl} \cong \sqrt{\frac{\hbar c}{G}}$ and $H_{pl} \cong \frac{1}{2}\sqrt{\frac{c^5}{G\hbar}}$.
(4) The proposed cosmic temperature relation can be derived with the following three hypothetical conditions: $\frac{GM_t M_{pl}}{r_t^2} \cong \left(\frac{c^4}{8\pi G}\right)$; $r_t \cong \left(\frac{2.898\times 10^{-3}}{2\pi T_t}\right)$ and $M_t \cong \left(\frac{c^3}{2GH_t}\right)$ where Planck mass and the Universe are being treated as 'point particles'. The derived relation is $T_t \cong \frac{\hbar c^3}{24.891 k_B G\sqrt{M_{pl}M_t}}$ and the denominator coefficient 24.891 is very close to $8\pi \cong 25.13274$.
(5) The Lambda model of cosmic age for (1+ z) = 1100 can be fitted accurately with $t \cong \left(\frac{1}{1+z}\right)^{\frac{3}{2}}\left(\frac{1}{H_0}\right) \cong \left(\frac{\sqrt{1+z}}{H_t}\right)$ where $H_t \cong \frac{c^3}{2GM_t} \cong \left(\frac{1}{H_{pl}}\right)\left(\frac{4\pi k_B T_t}{\hbar}\right)^2 \cong (1+z)^2 H_0$.
(6) The currently believed Baryon acoustic bubble radius [19,21] can be fitted with $(R_{BAO})_0 \cong \sqrt{\frac{T_0}{T_{\text{Recombination}}}} * \left(\frac{c}{H_0}\right) \cong \sqrt{\frac{2.725\text{ K}}{3000\text{ K}}} * \left(\frac{c}{H_0}\right) \cong \frac{c}{H_{\text{Recomb}}^{1/4} H_0^{3/4}} \cong 135$ Mpc.

(7) The currently believed cosmic red shift can also be defined as $z_{new} \cong \frac{\lambda_{Observed} - \lambda_{Lab}}{\lambda_{Observed}} \cong 1 - \frac{\lambda_{Lab}}{\lambda_{Observed}} \cong \frac{z}{z+1}$. Figure 1 compares galactic light travel distances according to our new definition, $d_G \cong (z_{new})(c/H_0)$ (red curve), and the conventional formula connected with dark energy density and other density fractions (green curve).For verification, readers are encouraged to visit these two URLs: http://www.atlasoftheuniverse.com/cosmodis.c (accessed on 17 February 2023) and https://cosmocalc.icrar.org/ (accessed on 17 February 2023). By considering $z_{new}c$ as the receding speed of the galaxy, Hubble's law [9] can be expressed as $v_G \cong H_0 d_G$. Conceptually, this relationship resembles cosmic light speed rotation. We are working in this direction.

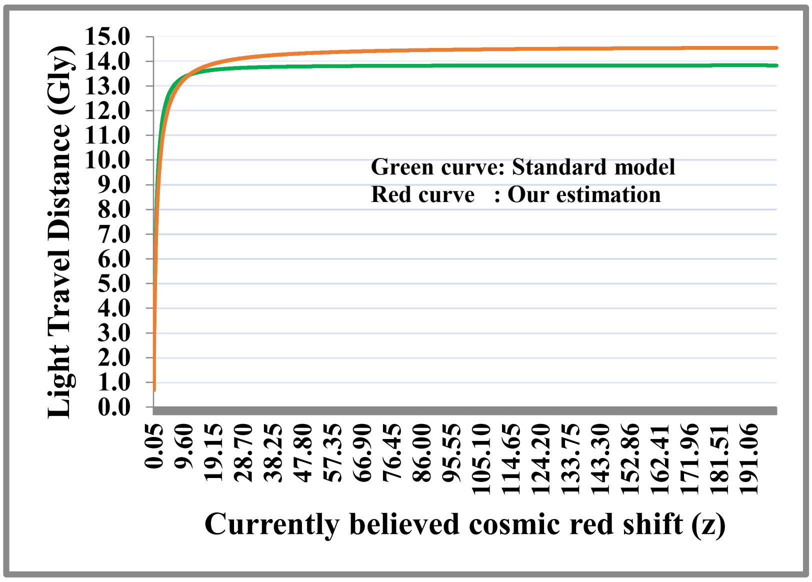

Figure 1. Comparison of standard and estimated light travel distances.

3. Our Four Basic Assumptions

Based on the above points and logics proposed in Sections 1 and 2,

(1) We emphasize the point that, without a radial in-flow of matter in all directions towards any one specific point, it may not be possible to have a big crunch and discussions on a centre-less universe having a big bang or big bounce seem to be meaningless;

(2) Considering the evolving universe as a growing black hole or simply a white hole [15,16], it seems natural to expect cosmic rotation.

In this section, considering the current Hubble's constant as an index of current cosmic angular velocity, we propose a simple model of a light speed expanding and light speed rotating model of cosmology. It needs a review at a fundamental level. It may be noted that our first assumption helps in understanding cosmic curvature, expansion speed, rotation speed and cosmic mass. The second assumption helps in understanding the relations between cosmic mass, cosmic temperature, expansion speed and rotation speed. The third assumption helps in understanding the super gravity of galactic baryon mass. The fourth assumption helps in understanding the galactic flat rotation speeds. From the beginning of Planck scale:

Assumption 1. *The universe is growing like a black hole, with light speed expansion and light speed rotation. Mathematically, it can be expressed as*

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

Assumption 2. *The universe is growing like a black hole with a scaled Hawking's black hole temperature formula. Mathematically, it can be expressed as*

$$T_t \cong \frac{\hbar c^3}{8\pi k_B G\sqrt{M_{pl}M_t}} \cong \frac{\hbar\sqrt{H_t H_{pl}}}{4\pi k_B} \cong \frac{\hbar\sqrt{\omega_t \omega_{pl}}}{4\pi k_B} \tag{2}$$

where $M_t \cong \frac{c^3}{2GH_t} \cong \frac{c^3}{2G\omega_t}$, $M_{pl} \cong \sqrt{\frac{\hbar c}{G}}$ and $H_{pl} \cong \omega_{pl} \cong \frac{1}{2}\sqrt{\frac{c^5}{G\hbar}}$.

It may be noted that this assumption certainly helps in eliminating the tension in estimating the magnitude of Hubble's parameter.

Assumption 3. *There exists no dark matter [27–30] and when the baryon mass of any galaxy crosses 180 to 200 million solar masses, the galaxy 'as a whole' experiences super gravity [17,21] in such a way that its effective or total mass can be expressed as*

$$(M_{Total})_G \cong \left\{ \left(M_{baryon}\right)_G + \left[\frac{\left(M_{baryon}\right)_G^{3/2}}{\sqrt{(M_{\text{limit}})_0}} \right] \right\} \tag{3}$$

where $(M_{\text{limit}})_0 \cong$ Current mass limit of ordinary gravity = 180 to 200 solar masses $\cong$ (3.6 to 4.0) $\times 10^{38}$ kg.*Starting from the recombination period, its current cosmological mass expression can be expressed as*

$$\frac{M_0}{(M_{\text{limit}})_0} \cong \exp\left(\sqrt{\frac{T_{\text{Recomb}}}{T_0}}\right)$$

where

$$M_0 \cong \frac{c^3}{2GH_0} \cong \frac{c^3}{2G\omega_0} \text{ and } \frac{T_{\text{Recomb}}}{T_0} \cong \frac{\text{Recombination temperature}}{\text{Current cos mic temperature}} \cong \frac{3000\text{ K}}{2.725\text{ K}}.$$

Assumption 4. *The current cosmic mass plays a vital role in understanding the observed galactic flat rotation speeds, in such a way that [23]*

$$\frac{V_G}{c} \cong \frac{1}{4}\left[\frac{(M_{Total})_G}{M_0}\right]^{1/4} \tag{4}$$

$$\begin{aligned} V_G &\cong 0.2973\left[G(M_{Total})_G(cH_0)\right]^{1/4} \\ &\cong 0.2973\left[G(M_{Total})_G(c\omega_0)\right]^{1/4} \end{aligned} \tag{5}$$

It may be noted that this relation is very similar to the famous MOND's formula [27]. An interesting point to be noted is that $(c\omega_0)$ can be considered as the upper limit of current cosmic acceleration. In addition to that, MOND's concept of weak gravity can be studied in terms of Mach's view on the universal role of cosmic distance background [31,32]. See Figure 2 for the estimated galactic flat rotation speeds.

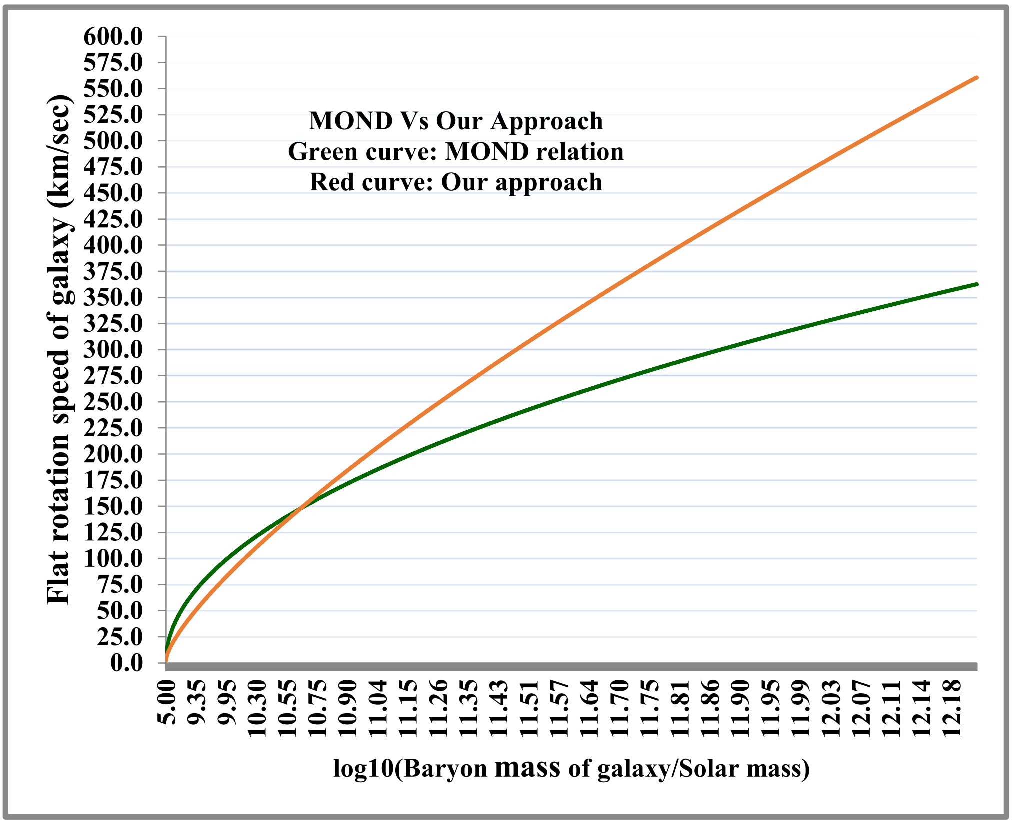

Figure 2. Galactic flat rotation speeds.

4. Discussion

Historically, Godel, Gamow, Whittakar, Hawking, Narlikar, Nodland, Ralston, Rubin, Birch, Korotky, Obukhov, Chechin, Sivaram, Magueijoand Longo, like many cosmologists, expressed their positive opinion on cosmic rotation [2–4,33–39]. Recent observations on cosmic anisotropy [40] and galactic spin directions seem to support the possible existence of cosmic rotation [2,41]. Most recent references [7,8] seem to shed light on the necessity of considering cosmic positive curvature, which is a major prerequisite for cosmic rotation. Even though the cosmological principle [42] has 100 years of strong footing, at present it is being suspected and seriously examined in many directions.

It may be noted that, by considering 'light speed rotation' and ignoring 'light speed expansion', Einstein's static universe can be made stable dynamically. There seems to be no need to introduce the 'Lambda term'. If the current universe is having a trend of deceleration, as proposed by Paul J. Steinhardt et al. and reviewed by Perlmutter, S. [43], by considering light speed rotation throughout the cosmic history, then there is scope for developing light speed rotating and decelerating models of cosmology [13]. We are working on understanding and validating the dual role of light speed in cosmic expansion and rotation. With ongoing observations, whether it is cosmic light speed expansion or light speed rotation can be explored in all possible ways.

From a quantum cosmology point of view, our views seem to have an interesting role. Clearly speaking, our assumptions are very clear and seem to incorporate Planck scale in current cosmic observations. Our assumptions (1) and (2) give a very nice explanation for the origin of the current cosmic temperature. It is well established that Hawking's findings about black holes and the universe [44] are the most important contributions to physics in recent decades. Hawking's proposed scaled black hole temperature formula can be given a chance in understanding and refining the views of Hawking's multi-universal paradigm. Hence, we appeal to the science community to recommend our rotating model of a Hubble–Hawking universe for further research and study. Based on assumptions (1) and (2), both cosmic thermal expansion and physical expansion can be studied in a unified manner. Based on assumptions (1) and (3), dark energy and dark matter concepts can be relinquished. Based on assumptions (1) and (4), the role of cosmic angular velocity and angular acceleration in galactic structures can be understood.

Based on relation (5), if one is willing to consider the current cosmic angular velocity as

$$\omega_0 \cong (0.2973)^4 H_0 \cong 1.694 \times 10^{-20} \text{ rad/ sec} \cong 5.345 \times 10^{-13} \text{ rad/year}. \quad (6)$$

This value is nicely fitting with the observational data associated with galactic rotation [37]. Another interesting theoretical coincidence is that

$$\left(\frac{3\omega_0^2 c^2}{8\pi G}\right) \div \left(aT_0^4\right) \cong \frac{3\omega_0^2 c^2}{8\pi G\left(aT_0^4\right)} \cong \frac{4.613 \times 10^{-14} \text{ J/m}^3}{4.169 \times 10^{-14} \text{ J/m}^3} \cong 1.1065 \quad (7)$$

Based on this coincidence, qualitatively and quantitatively, it is possible to guess that

$$\left.\begin{array}{c} \frac{3\omega_0^2 c^2}{8\pi G\left(aT_0^4\right)} \cong 1 \cong \frac{3\omega_t^2 c^2}{8\pi G\left(aT_t^4\right)} \\ \frac{\omega_0}{H_0} \cong \frac{\omega_t}{H_t} \cong \sqrt{\frac{1}{5760\pi}} \cong 0.0074338505 \end{array}\right\} \quad (8)$$

This number 0.0074338505 resembles the fine structure ratio $\alpha \cong 0.007297353$ which is equal to the ratio of the speed of an electron in the Bohr radius to the speed of light. A very interesting observation is $\ln\sqrt{\frac{M_0 V_0 R_0}{\hbar}} \cong 137.5 \cong \frac{1}{\alpha}$ where $M_0 \cong \frac{c^3}{2GH_0} \cong 9.311252 \times 10^{52}$ kg, $R_0 \cong \frac{c}{H_0} \cong 1.3828914 \times 10^{26}$ m, and $V_0 \cong c\sqrt{\frac{1}{5760\pi}} \cong 2.2286 \times 10^6$ m. sec^{-1}.

Now, assumption (1) can be modified as

$$R_t \cong \frac{2GM_t}{c^2} \cong \frac{c}{H_t} \cong \frac{V_t}{\omega_t} \quad (9)$$

where V_t = cosmic rotation speed and ω_t = cosmic angular velocity.

$$V_t \cong R_t \omega_t \cong \left(\frac{\omega_t}{H_t}\right) c \cong 0.0074339c \quad (10)$$

For the current case, based on relation (10), galactic flat rotation speed can be expressed as

$$\begin{array}{c} V_G \cong \left[G(M_{Total})_G (c\omega_0)\right]^{1/4} \cong \left[G(M_{Total})_G (V_0 H_0)\right]^{1/4} \\ \text{where } V_0 \cong 0.0074339c \end{array} \quad (11)$$

Now, based on assumptions (3) and (4) and following the generally believed gravitational law $GM = v^2 r$, radius of any galaxy can be expressed as [17]

$$R_G \cong \frac{G(M_{Total})_G}{V_G^2} \cong \sqrt{\frac{G(M_{Total})_G}{V_0 H_0}} \cong \sqrt{\frac{G(M_{Total})_G}{c\omega_0}} \quad (12)$$

For the Milky Way, based on its accepted flat rotation speed of $V_{MW} \cong 200$ km/ sec, its obtained total mass is $(M_{total})_{MW} \cong 4.962 \times 10^{42}$ kg $\cong 2.5 \times 10^{12} M_\odot$ and its corresponding radius is $R_{MW} \cong 8.28 \times 10^{21}$ m $\cong 268.4$ kpc. These values can be compared with recent estimates [45].

Considering relations (11) and (12), and by knowing the galactic flat rotation speeds, galactic total masses and galactic radii can be estimated without the need of currently believed 'dark matter halo' concepts and their complicated analytical procedures [46].

Based on relations (8) to (12), one can understand the potential applications of current cosmic angular velocity or rotation speed in exploring the constructional secrets of galaxies. It needs further study.

It may be noted that, considering a rotating and expanding model of cosmology, it seems possible to say that:

(1) Galaxies seem to follow an outward spiral path;
(2) Galaxies can be seemed to be arranged in a systematic order;
(3) Even though the present universe is believed to be accelerating, as the current expansion rate is very small, an increase in the separation distance between neighbouring galaxies seems to be negligible. Hence, the distance between neighbouring galaxies seems to be approximately fixed.

5. Conclusions

In this paper, considering the current Hubble constant as a limiting case of current angular velocity and considering the speed of light as a limiting case of current cosmic rotation speed, we have developed a simple model of rotating cosmology. Qualitatively and quantitatively, in a theoretical approach, compared to the historical arguments on cosmic rotation, our views seem to be more coherent, strongly connected with quantum gravity and are closer to observational findings. Hence, we sincerely appeal to the scientific community to recommend our rotating model of the universe for further research.

Author Contributions: U.V.S.S. has written the draft and S.L. has verified the content. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Figure 1 has been developed with reference to http://www.atlasoftheuniverse.com/cosmodis.c (accessed on 17 February 2023) and https://cosmocalc.icrar.org/ (accessed on 17 February 2023).

Conflicts of Interest: The authors declare that there exists no conflict of interest.

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