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# The Large Scale Universe as a Quasi Quantum White Hole

**U. V. S. Seshavatharam[1*], Eugene Terry Tatum[2] and S. Lakshminarayana[3]**

*[1]Honorary Faculty, I-SERVE, Survey no-42, Hitech city, Hyderabad-84,Telangana, India.*
*[2]760 Campbell Ln. Ste 106 #161, Bowling Green, KY, USA.*
*[3]Department of Nuclear Physics, Andhra University, Visakhapatnam-03, AP, India.*

***Authors' contributions***

*This work was carried out in collaboration among all authors. Author UVSS designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors ETT and SL managed the analyses of the study. All authors read and approved the final manuscript.*

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## ABSTRACT

We emphasize the point that, standard model of cosmology is basically a model of classical general relativity and it seems inevitable to have a revision with reference to quantum model of cosmology. Utmost important point to be noted is that, 'Spin' is a basic property of quantum mechanics and 'rotation' is a very common experience. In this context, we propose five assumptions in line with Planck mass as the baby universe. We appeal that, 1) Universe can be modelled as a time-reversed black hole (a white hole) with rotation and light speed expansion, and 2) 'Light speed expanding cosmic space' can be called as 'Flat space'. With reference to light speed expansion, if one is willing to re-define cosmic red shift as [z/(1+z)], without considering Lambda cosmology model of matter density fractions, light travel distances can be reproduced with marginal error. Advantages of our assumptions are, 1) A quantum model of cosmology can be developed with unification of general

**Corresponding author: E-mail: seshavatharam.uvs@gmail.com;*

theory of relativity and quantum mechanics. 2) Tension in estimating the current Hubble parameter can be eliminated via scaled Hawking's black hole temperature formula with great confidence. 3) Galactic dark matter and visible matter can be studied in a unified manner. 4) Galactic light travel distances can be estimated very easily without matter density fractions. 5) Big bang and inflation like non-general relativistic concepts can be relinquished with further study.

*Keywords: white hole cosmology; Planck mass as the baby universe; cosmic rotation; light speed expansion; dark matter; visible matter; galactic radii; galactic angular velocity.*

## LIST OF SYMBOLS

At any stage of cosmic evolution,

1) Cosmic time = $t$
2) Cosmic Hubble parameter = $H_t$
3) Cosmic angular velocity = $\omega_t$
4) Ratio of Hubble parameter to angular velocity = $\Upsilon_t$
5) Cosmic radius = $R_t$
6) Cosmic total mass = $M_t$
7) Cosmic temperature = $T_t$
8) Galactic star flat rotation speed = $V_{Gt}$
9) Galactic angular velocity = $\left(\omega_G\right)_t$
10) Visible mass of galaxy = $\left(M_{Gv}\right)_t$
11) Dark mass of galaxy = $\left(M_{Gd}\right)_t$
12) Total mass of galaxy = $\left(M_G\right)_t$
13) Time dependent dark-visible reference mass unit = $M_{Xt}$
14) Radius of galaxy = $\left(R_G\right)_t$
15) Angular velocity of galaxy = $\left(\omega_G\right)_t$
16) Wavelength of light received from observed galaxy = $\lambda_O$
17) Wavelength of light in laboratory = $\lambda_L$
18) Current cosmic red shift = $z_{current} = z_c = z$
19) New cosmic red shift = $z_{new} = z_n = \left(z_c / 1 + z_c\right) \leq 1$
20) Mean separation distance of any two neighboring galaxies = $L_{sep}$

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

## 1. INTRODUCTION

Modern cosmologists are seriously working on developing a peculiar model of relativistic cosmology that assumed to be started with a 'big bang' followed by a sudden and very short period exponential expansion called 'inflation' and a lately begun current acceleration. Big bang and inflation, both, seem to be the best widely accepted theoretical inferences of current large scale cosmic observations. But it is very clear to say that, both are having no proper theoretical base and no way connected with the basic concepts of general theory of relativity. In addition to that, currently believed cosmic acceleration is based on another widely accepted invisible and unidentified cosmic 'new energy source' called 'dark energy'. Apart from these three complicated cosmic issues, galactic observations strongly supporting the existence of yet another mysterious and invisible cosmic 'mass source' called 'dark matter'. It is very unfortunate to say that, so far, no one did establish a clear physical connection between

cosmic dark energy and dark matter. Thus on a whole, currently believed standard cosmology is facing many challenges and many remarks. Since it is being developed and maintained by highly qualified scientists and high level mathematics, so called 'standard model' of cosmology is strongly believed and shown to be in line with large scale cosmic observations that are completely depending on an ad-hoc and misleading definition of 'cosmic red shift' associated with light coming from distant galaxies. Here we would like to emphasize the point that, by modifying the basic definition of cosmic red shift, considering 'speed of light' as an absolute cosmic expansion rate and adopting 'Planck mass' as the basic seed of the observed large scale universe, it is certainly possible to review and revise the basic picture of 'standard cosmology' and in near future, a perfect model of 'quantum cosmology' can be developed. To proceed further, in the following section, we are trying to highlight some important motivating points.

## 2. MOTIVATING POINTS

Even though standard model of cosmology is standing on 5 pillars namely, big bang, inflation, super luminal expansion, dark matter and dark energy, we would like to emphasize that,

1. We stress the point 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 formation of big bang as supposed by cosmologists 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 - 'point' of big bang can be considered as the characteristic reference point of cosmic expansion in all directions. Thinking in this way, to some extent, point of big bang can be considered as a possible centre of cosmic evolution. If so, thinking about a centre-less universe is illogical.
2. Even though highly intuitive and brilliant, concepts of big bang and inflation are no way connected with General relativity. It is a well known fact. In this context one can find interesting information in "https://phys.org/news/2019-11-cosmologist-lonely-big-theory.html".
3. Theoretically big bang, inflation, dark energy and super luminal expansion are no way connected with Planck scale which is having a major role in understanding quantum cosmology having information passing at speed of light.
4. Experimentally so far no one could understand big bang [1,2] and inflation [3,4], dark energy, dark matter and super luminal expansion with reference to any underground or ground or satellite based experiment.
5. Big bang, inflation and Super luminal expansion are no way giving a clue for unifying general theory of relativity and quantum mechanics.
6. Even though most of the cosmological observations are being studied and understood with photons that propagate with speed of light, it is very unfortunate to say that, most of the cosmologists are strongly believing in hypothetical 'super luminal expansion' of space. Recently detected gravitational waves that are supposed to originate from massive black holes are also confirmed to be moving at speed of light. If so, superluminal expansion can be considered as a pure human intellectual concept having no experimental support.
7. Big bang, inflation and dark energy are inference based intellectual concepts having no proper physical base and probably may misguide the future generation.
8. Compared to Big bang, inflation, dark energy and superluminal expansion, dark matter is having some sort of physical support in terms of an unknown, unidentified and unseen elementary particle having an heuristic gravitational attractive property. In addition to that, ultimately somehow, one should suppose the existence of some kind of matter for understanding the unexpected massive nature of trillions of observed galaxies.
9. 'Spin' is a basic property of quantum mechanics and 'rotation' is a very common experience.
10. It is better to understand and develop models of cosmology based on well supported physical concepts rather than extraordinary physical hypothesis that demand super-normal efforts.

## 3. OUR FIVE ASSUMPTIONS

We emphasize the point that, standard model of cosmology is basically a model of classical model of general relativity and based on the points proposed in 'Introduction', it seems inevitable to bring a change with reference to quantum model of cosmology. In this context, we propose five different assumptions in line with Planck mass as the baby universe. First three assumptions are helpful in understanding the basic cosmic structure and 4th and 5th assumptions are helpful in understanding galactic structures.

Right from the beginning of Planck scale, cosmic boundary is moving at speed of light and growing like a ball with the following workable assumptions [5-19].

**Assumption-1**: If $R_t \cong 2GM_t/c^2 \cong c/H_t$, $M_t \cong c^3/2GH_t$, and $tH_t \cong 1$.

**Assumption-2**: With reference to Planck mass, cosmic temperature follows a scaled form of Hawking's black hole temperature relation, $T_t \cong \frac{\hbar c^3}{8\pi G k_B \sqrt{M_t M_{pl}}}$ where $M_{pl} \cong$ Planck mass.

**Assumption-3**: Ratio of Hubble parameter and angular velocity can be expressed as, $\frac{H_t}{\omega_t} \cong \Upsilon_t \cong 1+\ln\left(\frac{H_{pl}}{H_t}\right)$ where $H_{pl}$ is the Planck scale Hubble parameter.

**Assumption-4**: Galactic dark matter $(M_{Gd})_t$ and visible matter $(M_{Gv})_t$ are interrelated in such a way that, $M_{Gt} \cong (M_{Gd})_t + (M_{Gv})_t$ and $\frac{(M_{Gd})_t}{(M_{Gv})_t} \cong \sqrt{\frac{(M_{Gv})_t}{M_{Xt}}}$ where $M_{Xt} \cong \frac{\left(M_t^3 M_{pl}\right)^{\frac{1}{4}}}{8\pi} \cong$ Time dependent dark-visible reference mass unit.

**Assumption-5**: Galactic flat rotation speed can be expressed as, $\frac{V_{Gt}}{c} \cong \left(\frac{1}{2\Upsilon_t}\right)^{\frac{1}{4}}\left(\frac{M_{Gt}}{M_t}\right)^{\frac{1}{4}}$ where $M_t$ = Cosmic total mass.

## 4. ESTIMATION OF THE MAGNITUDES OF PLANCK SCALE PARAMETERS

For the Planck scale, if, total mass = $M_{pl} \cong \sqrt{\frac{\hbar c}{G}}$, based on the assumptions, Planck scale physical parameters like, mass, radius, angular velocity, Hubble parameter and temperature can be estimated with the following relations.

$$R_{pl} \cong \frac{2GM_{pl}}{c^2} \cong 2\sqrt{\frac{G\hbar}{c^3}} \cong 3.2325\times10^{-35}\,\text{m} \quad (1)$$

$$H_{pl} \cong \frac{c^3}{2GM_{pl}} \cong \frac{1}{2}\sqrt{\frac{c^5}{G\hbar}} \cong 9.27445\times10^{42}\,\text{sec}^{-1} \quad (2)$$

$$t_{pl} \cong \frac{1}{H_{pl}} \cong 2\sqrt{\frac{G\hbar}{c^5}} \cong 1.07823\times10^{-43}\,\text{sec} \quad (3)$$

$$\Upsilon_{pl} \cong \frac{H_{pl}}{\omega_{pl}} \cong 1 \quad (4)$$

$$T_{pl} \cong \frac{\hbar c^3}{8\pi G k_B M_{pl}} \cong 5.6373\times10^{30}\,\text{K} \quad (5)$$

$$\omega_{pl} \cong H_{pl} \cong 9.27445\times10^{42}\,\text{rad.sec}^{-1} \quad (6)$$

## 5. ESTIMATION OF THE MAGNITUDES OF CURRENT COSMIC PARAMETERS

Considering, current cosmic microwave background radiation (CMBR) temperature [20] as, $T_0 \cong 2.725$ K, current cosmic physical parameters like, mass, radius, angular velocity, Hubble parameter and galactic dark-visible reference mass unit can be estimated with the following relations.

$$M_0 \cong \frac{1}{M_{pl}}\left(\frac{\hbar c^3}{8\pi G k_B T_0}\right)^2 \cong 9.31453\times10^{52}\ \text{kg} \quad (7)$$

$$H_0 \cong \frac{c^3}{2GM_0} \cong 2.1671\times10^{-18}\ \text{sec}^{-1} \cong 66.87\ \text{km.sce}^{-1}\text{Mpc}^{-1} \quad (8)$$

$$\Upsilon_0 \cong 1+\ln\left(\frac{H_{pl}}{H_0}\right) \cong 140.61 \quad (9)$$

$$\omega_0 \cong \frac{H_0}{\Upsilon_0} \cong \frac{2.1671\times10^{-18}\ \text{sec}^{-1}}{140.61} \cong 1.5412\times10^{-20}\ \text{rad.sec}^{-1} \quad (10)$$

$$R_0 \cong \frac{c}{H_0} \cong 1.3834\times10^{26}\ \text{m} \quad (11)$$

$$t_0 \cong \frac{1}{H_0} \cong \frac{2GM_0}{c^3} \cong 14.62\ \text{Gy} \quad (12)$$

$$M_{X0} \cong \frac{\left(M_0^3 M_{pl}\right)^{\frac{1}{4}}}{8\pi} \cong 3.623\times10^{38}\ \text{kg} \quad (13)$$

## 6. THREE CHARACTERISTIC GALACTIC APPLICATIONS

Based on the assumptions, 3 characteristic properties of any galaxy can be expressed in the following way [16,17,18]. At present,

1) Radius of any galaxy can be expressed as [21,22]

$$R_G \cong \sqrt{\frac{GM_G}{c\omega_0}} \quad (14)$$

2) Angular velocity of any galaxy can be expressed as,

$$\omega_G \cong \frac{V_G^3}{GM_G} \quad (15)$$

3) Mean separation distance of any two neighboring galaxies can be expressed as,

$$L_{sep} \cong \left(\frac{\sqrt{V_{G1}V_{G2}}}{c}\right)\left(\frac{c}{H_0}\right) \cong \frac{\sqrt{V_{G1}V_{G2}}}{H_0} \quad (16)$$

where $\left(V_{G1}, V_{G2}\right)$ represent the flat rotation speeds of galaxies $\left(G1, G2\right)$.

It may be noted that, according to Baryonic acoustic oscillations, current galactic separation distance is around 490 million light years [23,24]. In this context, relation (16) can be recommended for further research.

## 7. GALACTIC DARK MASS, VISIBLE MASS, TOTAL MASS, RADIUS AND ANGULAR VELOCITY

Based on the assumptions and observed galactic flat rotations speeds taken from Spitzer Photometry and Accurate Rotation curves (SPARC) [25], in the following Table-1 we present the data for estimated galactic radii and angular velocities. Here it may be noted that, at present, for any galaxy, (ignoring the '0' subscript),

$$M_G \cong M_{Gd} + M_{Gv} \cong M_{Gv}\sqrt{\frac{M_{Gv}}{M_{X0}}} + M_{Gv} \cong M_{Gv}\left(1+\sqrt{\frac{M_{Gv}}{M_{X0}}}\right) \quad (17)$$

$$\frac{V_G}{c} \cong \left(\frac{1}{2\Upsilon_0}\right)^{\frac{1}{4}}\left(\frac{M_G}{M_0}\right)^{\frac{1}{4}} \cong 0.2442\left(\frac{M_G}{M_0}\right)^{\frac{1}{4}} \quad (18)$$

Replacing Modified Newtonian Dynamics (MOND) acceleration parameter with cosmic angular acceleration and replacing galactic visible mass with dark mass, relation (18) can be obtained. Considering a simple C++ program, relation (17) can be solved numerically. See Table 1. In most of the cases, estimated total mass of galaxy seems to be in line with galactic halo estimations made with Navarro–Frenk–White (NFW) model having marginal errors (http://astroweb.cwru.edu/SPARC/WP50_M200.mrt). It can be confirmed with columns (5), (6) of Table 1 and Fig. 1. Red curve is our estimation and green curve is for NFW model [26,27,28]. As total mass of galaxy is assumed to be proportional to 4$^{th}$ power of rotation speed, a small change in rotation speed will have large effect in galactic total mass. We have prepared Fig. 1 with respect to increasing galactic rotation speeds for a clear understanding. From the figure it is very clear that, for low rotation speeds, NFW estimated halo mass is on higher side and our estimated total mass is on lower side. Based on relation (14), if one is willing to consider the idea that, galactic radius is proportional to square root of its mass, it seems logical to say that, lower massive galaxies will have small radii and low rotation speeds. Here we would like appeal that, galaxies whose visible mass approaches our reference mass unit of $M_{X0} \cong 3.6\times10^{38}$ kg, seems to possess very little dark matter. It can be confirmed with very recent observations pertaining to NGC1052-DF2 and NGC1052-DF4 galaxies.

Recommended visible mass of NGC1052-DF2 [29,30,31] is $\approx 1\times10^8 M_{\text{Sun}}$ and its estimated dark mass is

$\approx \left( \left(2\times10^{38}\right)^{\frac{3}{2}} \Big/ \sqrt{3.6\times10^{38}} \right) \cong 1.49\times10^{38}$ kg. Sum of dark mass and visible mass is $\approx 0.35\times10^{9} M_{\text{Sun}}$. Corresponding flat rotation speed is 18.5 km/sec. It needs further study with respect to NGC1052-DF2 refined data. By means of tidal mass loss [32], if dark matter shifts from satellite galaxy to its mother galaxy, based on our proposed concepts, mother galaxy's flat rotation speed must increase significantly due to increase in total matter. It is for future observational testing.

## 8. UNDERSTANDING COSMIC RED SHIFT WITH SPEED OF LIGHT

It may be noted that, increased red shifts and increased distances forced Edwin Hubble to propose the Hubble's law [33]. With reference to laboratory, appropriate definition of red shift $(z)$ seems to be [34].

$$z_{new} \cong z_n \cong \frac{\lambda_O - \lambda_L}{\lambda_O} \cong 1 - \left(\frac{\lambda_L}{\lambda_O}\right) \le 1. \qquad (19)$$

But not $z_{current} \cong z_c \cong \frac{\lambda_O - \lambda_L}{\lambda_L} \cong \left(\frac{\lambda_O}{\lambda_L}\right) - 1$ (20)

Here, as usual, $\lambda_O$ is the wave length of light received from observed galaxy and $\lambda_L$ is the wave length of light in laboratory. Even though both relations are ad-hoc definitions, compared to relation (20), relation (19) seems to be appropriate with respect to 'light speed expansion'. Very interesting thing is that, when red shift is very small (up to $z \approx 0.01$ ), both relations almost all will give the same result. Important point to be noticed is that, by Hubble's time the maximum red shift noticed was 0.003.

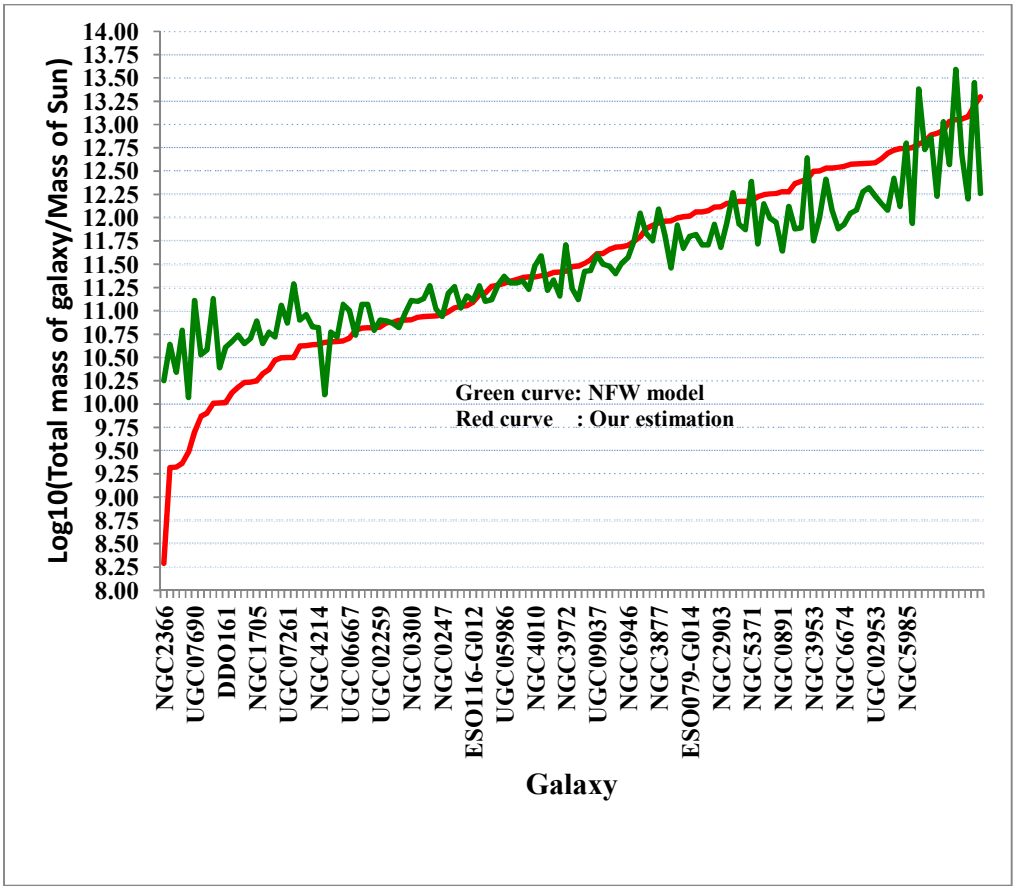


**Fig. 1. Comparison of estimated total mass of galaxy with NFW model**

**Table 1. Estimated galactic dark mass, visible mass, total mass, radius and angular velocity**

| Galaxy | Rotation speed (km/sec) | Error in rotation speed (km/sec) | Estimated total mass 1.989e40 (kg) | Log10 (Total mass of galaxy/ Mass of Sun) | Galactic halo mass (NFW model) | Estimated visible mass 1.989e40 (kg) | Estimated dark mass 1.989e40 (kg) | Dark mass% | Estimated radius of galaxy (kpc) | Estimated angular velocity of galaxy (rad/sec) |
|---|---|---|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| D631-7 | 57 | 9.4 | 1.72 | 10.24 | 10.7 | 0.33 | 1.39 | 80.94 | 22.79 | 8.11E-17 |
| DDO064 | 46.1 | 3.9 | 0.74 | 9.87 | 10.53 | 0.18 | 0.56 | 75.78 | 14.91 | 1.00E-16 |
| DDO154 | 47 | 1 | 0.80 | 9.90 | 10.58 | 0.19 | 0.61 | 76.30 | 15.49 | 9.83E-17 |
| DDO161 | 66.3 | 1.9 | 3.15 | 10.50 | 10.87 | 0.50 | 2.65 | 84.02 | 30.83 | 6.97E-17 |
| DDO168 | 53.4 | 1.9 | 1.33 | 10.12 | 10.67 | 0.27 | 1.05 | 79.46 | 20.00 | 8.65E-17 |
| DDO170 | 60 | 1.6 | 2.11 | 10.32 | 10.65 | 0.38 | 1.73 | 82.04 | 25.25 | 7.70E-17 |
| ESO079-G014 | 175 | 3.5 | 152.90 | 12.18 | 12.39 | 7.28 | 145.62 | 95.24 | 214.80 | 2.64E-17 |
| ESO116-G012 | 109.1 | 3.1 | 23.10 | 11.36 | 11.49 | 2.01 | 21.09 | 91.30 | 83.49 | 4.24E-17 |
| ESO563-G021 | 314.6 | 11.7 | 1596.97 | 13.20 | 13.45 | 35.41 | 1561.55 | 97.78 | 694.19 | 1.47E-17 |
| F561-1 | 50 | 2.9 | 1.02 | 10.01 | 11.13 | 0.23 | 0.79 | 77.88 | 17.53 | 9.24E-17 |
| F563-V2 | 116.6 | 9.4 | 30.13 | 11.48 | 11.12 | 2.41 | 27.73 | 92.00 | 95.36 | 3.96E-17 |
| F568-V1 | 112.3 | 15.8 | 25.93 | 11.41 | 11.16 | 2.17 | 23.76 | 91.61 | 88.45 | 4.11E-17 |
| F571-8 | 139.7 | 4.3 | 62.09 | 11.79 | 12.05 | 3.95 | 58.15 | 93.64 | 136.88 | 3.31E-17 |
| F571-V1 | 83.6 | 3.5 | 7.96 | 10.90 | 10.98 | 0.96 | 7.00 | 87.91 | 49.02 | 5.53E-17 |
| F574-1 | 97.8 | 4.1 | 14.91 | 11.17 | 11.27 | 1.49 | 13.43 | 90.03 | 67.09 | 4.72E-17 |
| F579-V1 | 112.1 | 13.4 | 25.74 | 11.41 | 11.33 | 2.16 | 23.58 | 91.60 | 88.14 | 4.12E-17 |
| F583-1 | 85.8 | 3.6 | 8.84 | 10.95 | 11.02 | 1.03 | 7.80 | 88.29 | 51.63 | 5.39E-17 |
| IC2574 | 66.4 | 2 | 3.17 | 10.50 | 11.29 | 0.51 | 2.66 | 84.05 | 30.92 | 6.96E-17 |
| IC4202 | 242.6 | 11 | 564.71 | 12.75 | 11.94 | 17.60 | 547.11 | 96.88 | 412.80 | 1.90E-17 |
| KK98-251 | 33.7 | 1.6 | 0.21 | 9.32 | 10.34 | 0.07 | 0.14 | 66.38 | 7.97 | 1.37E-16 |
| NGC0024 | 106.3 | 7.9 | 20.82 | 11.32 | 11.3 | 1.87 | 18.95 | 91.02 | 79.26 | 4.35E-17 |
| NGC0055 | 85.6 | 5 | 8.75 | 10.94 | 11.27 | 1.03 | 7.73 | 88.25 | 51.39 | 5.40E-17 |
| NGC0100 | 88.1 | 6.4 | 9.82 | 10.99 | 11.19 | 1.11 | 8.71 | 88.66 | 54.44 | 5.24E-17 |
| NGC0247 | 104.9 | 8 | 19.74 | 11.30 | 11.37 | 1.80 | 17.94 | 90.87 | 77.18 | 4.40E-17 |
| NGC0289 | 163 | 8 | 115.08 | 12.06 | 11.82 | 6.01 | 109.08 | 94.78 | 186.35 | 2.83E-17 |

| Galaxy | Rotation speed (km/sec) | Error in rotation speed (km/sec) | Estimated total mass 1.989e40 (kg) | Log10 (Total mass of galaxy/ Mass of Sun) | Galactic halo mass (NFW model) | Estimated visible mass 1.989e40 (kg) | Estimated dark mass 1.989e40 (kg) | Dark mass% | Estimated radius of galaxy (kpc) | Estimated angular velocity of galaxy (rad/sec) |
|---|---|---|---|---|---|---|---|---|---|---|
| NGC0300 | 93.3 | 7 | 12.35 | 11.09 | 11.11 | 1.31 | 11.05 | 89.44 | 61.06 | 4.95E-17 |
| NGC0801 | 220 | 16.2 | 381.90 | 12.58 | 12.32 | 13.52 | 368.39 | 96.46 | 339.47 | 2.10E-17 |
| NGC0891 | 216.1 | 5.7 | 355.53 | 12.55 | 11.93 | 12.88 | 342.65 | 96.38 | 327.54 | 2.14E-17 |
| NGC1003 | 109.8 | 4.2 | 23.70 | 11.37 | 11.59 | 2.04 | 21.65 | 91.37 | 84.56 | 4.21E-17 |
| NGC1090 | 164.4 | 3.7 | 119.09 | 12.08 | 11.71 | 6.15 | 112.94 | 94.84 | 189.57 | 2.81E-17 |
| NGC1705 | 71.9 | 4.3 | 4.36 | 10.64 | 10.82 | 0.63 | 3.73 | 85.49 | 36.26 | 6.43E-17 |
| NGC2366 | 50.2 | 3.2 | 1.04 | 10.02 | 10.61 | 0.23 | 0.81 | 77.98 | 17.68 | 9.20E-17 |
| NGC2403 | 131.2 | 4.9 | 48.31 | 11.68 | 11.4 | 3.33 | 44.98 | 93.11 | 120.73 | 3.52E-17 |
| NGC2683 | 154 | 8.1 | 91.69 | 11.96 | 11.81 | 5.15 | 86.55 | 94.39 | 166.34 | 3.00E-17 |
| NGC2841 | 284.8 | 8.6 | 1072.56 | 13.03 | 12.57 | 27.10 | 1045.46 | 97.47 | 568.91 | 1.62E-17 |
| NGC2903 | 184.6 | 5.6 | 189.32 | 12.28 | 11.64 | 8.42 | 180.91 | 95.55 | 239.01 | 2.50E-17 |
| NGC2915 | 83.5 | 6.3 | 7.93 | 10.90 | 10.82 | 0.96 | 6.97 | 87.89 | 48.90 | 5.53E-17 |
| NGC2976 | 85.4 | 3.3 | 8.67 | 10.94 | 11.13 | 1.02 | 7.65 | 88.22 | 51.15 | 5.41E-17 |
| NGC2998 | 209.9 | 8.1 | 316.45 | 12.50 | 12 | 11.91 | 304.55 | 96.24 | 309.02 | 2.20E-17 |
| NGC3109 | 66.2 | 2.6 | 3.13 | 10.50 | 11.06 | 0.50 | 2.63 | 83.99 | 30.74 | 6.98E-17 |
| NGC3198 | 150.1 | 3.9 | 82.75 | 11.92 | 11.75 | 4.80 | 77.95 | 94.20 | 158.02 | 3.08E-17 |
| NGC3521 | 213.7 | 15.9 | 340.00 | 12.53 | 12.41 | 12.50 | 327.51 | 96.32 | 320.31 | 2.16E-17 |
| NGC3726 | 168 | 6.2 | 129.87 | 12.11 | 11.93 | 6.52 | 123.35 | 94.98 | 197.96 | 2.75E-17 |
| NGC3741 | 50.1 | 2.1 | 1.03 | 10.01 | 10.39 | 0.23 | 0.80 | 77.93 | 17.61 | 9.22E-17 |
| NGC3769 | 118.6 | 8.4 | 32.26 | 11.51 | 11.42 | 2.53 | 29.73 | 92.17 | 98.66 | 3.90E-17 |
| NGC3877 | 168.4 | 5.1 | 131.11 | 12.12 | 11.68 | 6.56 | 124.55 | 95.00 | 198.90 | 2.74E-17 |
| NGC3893 | 174 | 8.9 | 149.44 | 12.17 | 11.93 | 7.17 | 142.27 | 95.20 | 212.35 | 2.66E-17 |
| NGC3917 | 135.9 | 4.1 | 55.61 | 11.75 | 11.75 | 3.66 | 51.95 | 93.41 | 129.54 | 3.40E-17 |
| NGC3949 | 163 | 7.1 | 115.08 | 12.06 | 11.71 | 6.01 | 109.08 | 94.78 | 186.35 | 2.83E-17 |
| NGC3953 | 220.8 | 6.1 | 387.49 | 12.59 | 12.23 | 13.65 | 373.84 | 96.48 | 341.95 | 2.09E-17 |
| NGC3972 | 132.7 | 2.9 | 50.55 | 11.70 | 11.57 | 3.43 | 47.12 | 93.21 | 123.51 | 3.48E-17 |
| NGC3992 | 241 | 5.2 | 549.96 | 12.74 | 12.12 | 17.29 | 532.67 | 96.86 | 407.38 | 1.92E-17 |
| NGC4010 | 125.8 | 4.7 | 40.83 | 11.61 | 11.6 | 2.97 | 37.86 | 92.73 | 111.00 | 3.67E-17 |

| Galaxy | Rotation speed (km/sec) | Error in rotation speed (km/sec) | Estimated total mass 1.989e40 (kg) | Log10 (Total mass of galaxy/ Mass of Sun) | Galactic halo mass (NFW model) | Estimated visible mass 1.989e40 (kg) | Estimated dark mass 1.989e40 (kg) | Dark mass% | Estimated radius of galaxy (kpc) | Estimated angular velocity of galaxy (rad/sec) |
|---|---|---|---|---|---|---|---|---|---|---|
| NGC4013 | 172.9 | 7.1 | 145.69 | 12.16 | 12.27 | 7.05 | 138.65 | 95.16 | 209.68 | 2.67E-17 |
| NGC4051 | 157 | 5.5 | 99.05 | 12.00 | 11.92 | 5.43 | 93.63 | 94.52 | 172.89 | 2.94E-17 |
| NGC4085 | 131.5 | 4.8 | 48.75 | 11.69 | 11.51 | 3.35 | 45.40 | 93.13 | 121.29 | 3.51E-17 |
| NGC4088 | 171.7 | 6.9 | 141.69 | 12.15 | 11.94 | 6.92 | 134.78 | 95.12 | 206.78 | 2.69E-17 |
| NGC4100 | 158.2 | 5 | 102.11 | 12.01 | 11.67 | 5.54 | 96.58 | 94.58 | 175.54 | 2.92E-17 |
| NGC4138 | 147.3 | 5.9 | 76.75 | 11.89 | 11.83 | 4.56 | 72.19 | 94.06 | 152.18 | 3.14E-17 |
| NGC4157 | 184.7 | 7.2 | 189.73 | 12.28 | 12.12 | 8.43 | 181.30 | 95.56 | 239.27 | 2.50E-17 |
| NGC4183 | 110.6 | 5.4 | 24.39 | 11.39 | 11.22 | 2.09 | 22.31 | 91.45 | 85.80 | 4.18E-17 |
| NGC4214 | 80.1 | 5.8 | 6.71 | 10.83 | 10.9 | 0.85 | 5.86 | 87.26 | 45.00 | 5.77E-17 |
| NGC4217 | 181.3 | 7.2 | 176.14 | 12.25 | 12.15 | 8.01 | 168.13 | 95.45 | 230.55 | 2.55E-17 |
| NGC4559 | 121.2 | 5.1 | 35.18 | 11.55 | 11.43 | 2.68 | 32.50 | 92.38 | 103.03 | 3.81E-17 |
| NGC5005 | 262.2 | 20.7 | 770.53 | 12.89 | 12.86 | 21.70 | 748.84 | 97.18 | 482.20 | 1.76E-17 |
| NGC5033 | 194.2 | 3.6 | 231.88 | 12.37 | 11.88 | 9.65 | 222.23 | 95.84 | 264.52 | 2.38E-17 |
| NGC5055 | 179 | 4.9 | 167.37 | 12.22 | 11.72 | 7.74 | 159.63 | 95.37 | 224.73 | 2.58E-17 |
| NGC5371 | 209.5 | 3.9 | 314.05 | 12.50 | 11.75 | 11.85 | 302.21 | 96.23 | 307.84 | 2.21E-17 |
| NGC5585 | 90.3 | 2.4 | 10.84 | 11.04 | 11.26 | 1.19 | 9.65 | 89.00 | 57.19 | 5.12E-17 |
| NGC5907 | 215 | 2.9 | 348.35 | 12.54 | 11.88 | 12.71 | 335.65 | 96.35 | 324.22 | 2.15E-17 |
| NGC5985 | 293.6 | 8.6 | 1211.39 | 13.08 | 12.2 | 29.41 | 1181.99 | 97.57 | 604.61 | 1.57E-17 |
| NGC6015 | 154.1 | 7 | 91.93 | 11.96 | 11.46 | 5.16 | 86.78 | 94.39 | 166.56 | 3.00E-17 |
| NGC6195 | 251.7 | 9.3 | 654.33 | 12.82 | 12.73 | 19.44 | 634.89 | 97.03 | 444.35 | 1.84E-17 |
| NGC6503 | 116.3 | 2.4 | 29.82 | 11.47 | 11.24 | 2.39 | 27.44 | 91.98 | 94.87 | 3.97E-17 |
| NGC6674 | 241.3 | 4.9 | 552.70 | 12.74 | 12.8 | 17.35 | 535.36 | 96.86 | 408.39 | 1.91E-17 |
| NGC6946 | 158.9 | 10.9 | 103.93 | 12.02 | 11.8 | 5.61 | 98.33 | 94.61 | 177.10 | 2.91E-17 |
| NGC7331 | 239 | 5.4 | 531.93 | 12.73 | 12.42 | 16.91 | 515.03 | 96.82 | 400.64 | 1.93E-17 |
| NGC7814 | 218.9 | 7 | 374.32 | 12.57 | 12.05 | 13.34 | 360.99 | 96.44 | 336.09 | 2.11E-17 |
| PGC51017 | 18.6 | 1.3 | 0.02 | 8.29 | 10.25 | 0.01 | 0.01 | 43.91 | 2.43 | 2.48E-16 |
| UGC00128 | 129.3 | 2.8 | 45.57 | 11.66 | 11.48 | 3.20 | 42.37 | 92.98 | 117.26 | 3.57E-17 |
| UGC00731 | 73.3 | 2.3 | 4.71 | 10.67 | 10.72 | 0.67 | 4.04 | 85.82 | 37.69 | 6.30E-17 |

| Galaxy | Rotation speed (km/sec) | Error in rotation speed (km/sec) | Estimated total mass 1.989e40 (kg) | Log10 (Total mass of galaxy/ Mass of Sun) | Galactic halo mass (NFW model) | Estimated visible mass 1.989e40 (kg) | Estimated dark mass 1.989e40 (kg) | Dark mass% | Estimated radius of galaxy (kpc) | Estimated angular velocity of galaxy (rad/sec) |
|---|---|---|---|---|---|---|---|---|---|---|
| UGC01230 | 103.7 | 6.1 | 18.85 | 11.28 | 11.28 | 1.75 | 17.11 | 90.73 | 75.43 | 4.46E-17 |
| UGC01281 | 55.2 | 3.5 | 1.51 | 10.18 | 10.74 | 0.30 | 1.22 | 80.22 | 21.37 | 8.37E-17 |
| UGC02259 | 86.2 | 2.9 | 9.00 | 10.95 | 10.94 | 1.05 | 7.95 | 88.35 | 52.12 | 5.36E-17 |
| UGC02487 | 332 | 3.5 | 1980.67 | 13.30 | 12.26 | 40.92 | 1939.77 | 97.93 | 773.10 | 1.39E-17 |
| UGC02885 | 289.5 | 12 | 1145.13 | 13.06 | 12.67 | 28.32 | 1116.82 | 97.53 | 587.84 | 1.60E-17 |
| UGC02916 | 182.7 | 6.9 | 181.64 | 12.26 | 11.95 | 8.18 | 173.47 | 95.49 | 234.12 | 2.53E-17 |
| UGC02953 | 264.9 | 6 | 802.77 | 12.90 | 12.23 | 22.30 | 780.47 | 97.22 | 492.18 | 1.74E-17 |
| UGC03205 | 219.6 | 8.6 | 379.13 | 12.58 | 12.28 | 13.46 | 365.69 | 96.45 | 338.24 | 2.10E-17 |
| UGC03546 | 196.9 | 7.4 | 245.04 | 12.39 | 11.89 | 10.02 | 235.03 | 95.91 | 271.93 | 2.35E-17 |
| UGC03580 | 126.2 | 3.2 | 41.35 | 11.62 | 11.5 | 2.99 | 38.36 | 92.76 | 111.71 | 3.66E-17 |
| UGC04278 | 91.4 | 4.8 | 11.38 | 11.06 | 11.16 | 1.23 | 10.15 | 89.16 | 58.59 | 5.06E-17 |
| UGC04305 | 34.5 | 2.7 | 0.23 | 9.36 | 10.79 | 0.08 | 0.16 | 67.14 | 8.35 | 1.34E-16 |
| UGC04325 | 90.9 | 2.7 | 11.13 | 11.05 | 11.03 | 1.21 | 9.92 | 89.09 | 57.95 | 5.08E-17 |
| UGC04499 | 72.8 | 2.4 | 4.58 | 10.66 | 10.1 | 0.65 | 3.93 | 85.71 | 37.17 | 6.35E-17 |
| UGC05005 | 98.9 | 7.2 | 15.60 | 11.19 | 11.1 | 1.53 | 14.07 | 90.17 | 68.60 | 4.67E-17 |
| UGC05253 | 213.71 | 7 | 340.06 | 12.53 | 12.08 | 12.50 | 327.57 | 96.32 | 320.34 | 2.16E-17 |
| UGC05716 | 73.1 | 1.2 | 4.66 | 10.67 | 10.77 | 0.66 | 4.00 | 85.78 | 37.48 | 6.32E-17 |
| UGC05721 | 79.7 | 6.6 | 6.58 | 10.82 | 10.79 | 0.84 | 5.74 | 87.19 | 44.55 | 5.80E-17 |
| UGC05986 | 113 | 4.1 | 26.58 | 11.42 | 11.71 | 2.21 | 24.37 | 91.68 | 89.56 | 4.09E-17 |
| UGC06399 | 85 | 3.8 | 8.51 | 10.93 | 11.1 | 1.01 | 7.50 | 88.15 | 50.68 | 5.44E-17 |
| UGC06446 | 82.2 | 4.3 | 7.44 | 10.87 | 10.89 | 0.92 | 6.53 | 87.66 | 47.39 | 5.62E-17 |
| UGC06614 | 199.8 | 16 | 259.80 | 12.41 | 12.64 | 10.42 | 249.39 | 95.99 | 280.00 | 2.31E-17 |
| UGC06628 | 41.8 | 6.4 | 0.50 | 9.70 | 11.11 | 0.13 | 0.36 | 73.08 | 12.26 | 1.11E-16 |
| UGC06667 | 83.8 | 3.1 | 8.04 | 10.91 | 11.11 | 0.97 | 7.07 | 87.94 | 49.25 | 5.51E-17 |
| UGC06786 | 219.4 | 7.8 | 377.75 | 12.58 | 12.08 | 13.42 | 364.33 | 96.45 | 337.62 | 2.11E-17 |
| UGC06787 | 248.1 | 4.8 | 617.69 | 12.79 | 13.38 | 18.70 | 599.00 | 96.97 | 431.73 | 1.86E-17 |
| UGC06818 | 71.2 | 4 | 4.19 | 10.62 | 10.9 | 0.62 | 3.57 | 85.32 | 35.56 | 6.49E-17 |
| UGC06917 | 108.7 | 3.5 | 22.76 | 11.36 | 11.32 | 1.99 | 20.77 | 91.26 | 82.87 | 4.25E-17 |

| Galaxy | Rotation speed (km/sec) | Error in rotation speed (km/sec) | Estimated total mass 1.989e40 (kg) | Log10 (Total mass of galaxy/ Mass of Sun) | Galactic halo mass (NFW model) | Estimated visible mass 1.989e40 (kg) | Estimated dark mass 1.989e40 (kg) | Dark mass% | Estimated radius of galaxy (kpc) | Estimated angular velocity of galaxy (rad/sec) |
|---|---|---|---|---|---|---|---|---|---|---|
| UGC06923 | 79.6 | 2.5 | 6.55 | 10.82 | 11.07 | 0.84 | 5.71 | 87.16 | 44.44 | 5.80E-17 |
| UGC06930 | 107.2 | 5.1 | 21.53 | 11.33 | 11.3 | 1.91 | 19.62 | 91.11 | 80.60 | 4.31E-17 |
| UGC06973 | 174.2 | 6.2 | 150.13 | 12.18 | 11.87 | 7.19 | 142.94 | 95.21 | 212.84 | 2.65E-17 |
| UGC06983 | 109 | 5.8 | 23.01 | 11.36 | 11.23 | 2.00 | 21.01 | 91.29 | 83.33 | 4.24E-17 |
| UGC07125 | 65.2 | 2.1 | 2.95 | 10.47 | 10.72 | 0.48 | 2.47 | 83.70 | 29.82 | 7.09E-17 |
| UGC07151 | 73.5 | 2.8 | 4.76 | 10.68 | 11.07 | 0.67 | 4.09 | 85.87 | 37.89 | 6.29E-17 |
| UGC07261 | 74.7 | 3.4 | 5.08 | 10.71 | 11 | 0.70 | 4.37 | 86.14 | 39.14 | 6.19E-17 |
| UGC07399 | 103 | 3.3 | 18.35 | 11.26 | 11.12 | 1.71 | 16.64 | 90.66 | 74.41 | 4.49E-17 |
| UGC07524 | 79.5 | 3.6 | 6.51 | 10.81 | 11.07 | 0.84 | 5.68 | 87.15 | 44.33 | 5.81E-17 |
| UGC07603 | 61.6 | 2.8 | 2.35 | 10.37 | 10.77 | 0.41 | 1.94 | 82.58 | 26.61 | 7.50E-17 |
| UGC07690 | 57.4 | 3.2 | 1.77 | 10.25 | 10.89 | 0.33 | 1.44 | 81.09 | 23.11 | 8.05E-17 |
| UGC08286 | 82.4 | 2.3 | 7.52 | 10.88 | 10.87 | 0.93 | 6.59 | 87.69 | 47.62 | 5.61E-17 |
| UGC08490 | 78.6 | 3.8 | 6.22 | 10.79 | 10.74 | 0.81 | 5.41 | 86.97 | 43.33 | 5.88E-17 |
| UGC08550 | 56.9 | 1.9 | 1.71 | 10.23 | 10.65 | 0.33 | 1.38 | 80.90 | 22.71 | 8.12E-17 |
| UGC08699 | 182.4 | 6.9 | 180.45 | 12.26 | 11.99 | 8.15 | 172.31 | 95.49 | 233.35 | 2.53E-17 |
| UGC09037 | 152.3 | 9.6 | 87.71 | 11.94 | 12.09 | 5.00 | 82.72 | 94.31 | 162.69 | 3.03E-17 |
| UGC09133 | 226.8 | 4.2 | 431.35 | 12.63 | 12.15 | 14.68 | 416.68 | 96.60 | 360.78 | 2.04E-17 |
| UGC09992 | 33.6 | 3.3 | 0.21 | 9.32 | 10.64 | 0.07 | 0.14 | 66.25 | 7.92 | 1.38E-16 |
| UGC10310 | 71.4 | 3.9 | 4.24 | 10.63 | 10.96 | 0.62 | 3.62 | 85.37 | 35.76 | 6.47E-17 |
| UGC11455 | 269.4 | 7.4 | 858.72 | 12.93 | 13.03 | 23.34 | 835.39 | 97.28 | 509.04 | 1.72E-17 |
| UGC11914 | 288.1 | 10.5 | 1123.14 | 13.05 | 13.59 | 27.96 | 1095.19 | 97.51 | 582.17 | 1.60E-17 |
| UGC12506 | 234 | 16.8 | 488.79 | 12.69 | 12.08 | 15.97 | 472.83 | 96.73 | 384.05 | 1.97E-17 |
| UGC12632 | 71.7 | 2.8 | 4.31 | 10.63 | 10.83 | 0.63 | 3.68 | 85.44 | 36.06 | 6.44E-17 |
| UGCA444 | 37 | 4.8 | 0.31 | 9.49 | 10.07 | 0.09 | 0.21 | 69.39 | 9.60 | 1.25E-16 |

With reference to relation (20), relation (19) can be expressed as,

$$z_n \cong \frac{z_c}{1+z_c} \leq 1 \quad (21)$$

Based on this new definition, farthest galaxies distance can be estimated very easily. For example, see the following Table 2. We sincerely appeal that, on cosmological scales, 2.5% is not at all a 'serious' error. We would like to emphasize the point that, conceptually, we are no way deviating from the basic idea of expanding universe and receding galaxies. Only thing is that, we are confining to 'light speed expansion' and 'light speed receding'. With further study, there is a scope for understanding the universe in a unified approach. Since most of the cosmological observations are being studied with photons that move at speed of light, rather than 'working on controversial cosmic 'acceleration' and 'flatness' phenomena [35,15], it is better to work on understanding the root causes of 'speed of light'.

Richard Powell has written an online C program (http://www.atlasoftheuniverse.com/cosmodis.c) (version 1.1) for estimating the light travel distance. For a summary of the used formulae, one can refer David Hogg [36]. Using that program and considering a red shift of $z_c$ = (0.1 to 200), we have prepared Figure-2. Green curve indicates the light travel distance in Lambda cosmology prepared with Omega matter = 0.32, Omega lambda = 0.68, Omega radiation = 0.0 and $H_0$ = 66.87 km/sec/Mpc. Red curve indicates our estimated light travel distance $\left[z_c/(1+z_c)\right](c/H_0) \cong [z_n](c/H_0)$ where $H_0$ = 66.87 km/sec/Mpc. As traditional red shift is increasing, error in estimated light travel distance is increasing to +8.59% at $z_c \cong 1.20$ and from there onwards, error is reaching to 0% at $z_c \cong 11.5 \text{ to } 11.55.$ Proceeding further, error is reaching to -5.14% at $z_c \cong 200.0.$ Here, 'positive error' means, traditional light travel distance is higher than our estimate and 'negative error' means, traditional light travel distance is lower than our estimate. This can be also be confirmed with other online cosmic redshift-distance calculators written by Aaron Robotham and Joseph Dunne (https://cosmocalc.icrar.org/).

Based on the two curves presented in Figure-2, it is certainly possible to say that, if 'light travel distance' is a characteristic index in Lambda cosmology, the same index, can also be understood with our re-defined red shift relation (19) and 'light speed expansion'. 'An interesting feature' is that the ratio of 'comoving distance' and 'light travel distance' is marginally and approximately equal to $\exp(z_n).$ We are working in this direction.

With reference to relation (21), relation (20) can be expressed as,

$$\text{Traditional redshift, } z_c \cong \frac{z_n}{1-z_n} \quad (22)$$

Relation (22) indicates that, for increasing light travel distances, $z_c$ seems to have higher values compared to re-defined red shift $z_n$. See Figure 3. Red curve indicates our re-defined red shift and green curve indicates traditional red shift. To some extent, based on relations (21) and (22), it is possible to guess that, currently believed cosmic acceleration can be considered as an alternative interpretation associated with the alternative relation (20). It needs further study with respect to galactic red shifts and star rotation curves etc. Among relations (19) and (20), the correct definition can be decided with future observations.

## 9. UNDERSTANDING AND MODIFYING LAMBDA COSMOLOGY

With reference to traditional cosmology, understanding 'Lambda term' or 'cosmological constant' is a very difficult task. We would like to emphasize that, quantum cosmology point of either Lambda term or cosmological constant can be understood very easily. By considering Planck scale as the origin and growing Planck ball as a sequel of cosmic evolution, it is very simple to understand the cosmic physics. In this context, we appeal that,

1) Even though highly intuitive and impressive, there is no clarity and proper physical support for 'big bang' and 'inflation' concepts.
2) Lambda term can be expressed as a scalar quantity having the form, $\Lambda_t \cong \frac{3}{R_t^2} \cong \frac{3H_t^2}{c^2}.$
3) Similarly, cosmological constant can be expressed as a scalar quantity having the form, $\frac{\Lambda_t c^4}{8\pi G}.$

4) Based on the assumptions, total mass energy density and critical energy density, both are identical.
5) At any stage of cosmic evolution, $\frac{3c^2H_t^2}{8\pi G}-\frac{\Lambda_t c^4}{8\pi G}\cong 0$. Clearly speaking, if one is willing to consider $\left(\frac{\Lambda_t c^4}{8\pi G}\right)$ as a characteristic expression for 'dark energy density', it can be inferred that, at any stage of cosmic evolution, difference of dark energy density and mass-energy density is always 'zero' and universe is always expanding at speed of light.
6) Frankly speaking, if universe is really expanding with 'speed of light', unphysical Lambda term and its inherited dark energy term, both can be relinquished forever. It needs further investigation.
7) In Lambda cosmology, matter creation is associated with big bang. Based on the assumptions, matter is being created continuously with an expression of the form, $M_t\cong\frac{c^3}{2GH_t}\cong\frac{c^3t}{2G}$.
8) Cosmic Temperature-Time relation can be expressed as, $T_t\cong\frac{0.18511\times10^{10}}{\sqrt{t}}\text{K}$. This relation is almost similar to the mainstream relation derived on big bang concepts. Only difference is that, for the same expected temperatures, our estimated cosmic physical processes are taking place early compared to big bang model. This idea helps in understanding the early formation of galaxies at the cosmic dawn.
9) Most important thing is that the characteristic cosmic expansion rate can be accurately estimated by knowing the CMBR temperature and there is no need to take the help of galactic red shifts and galactic distances.
10) Estimated galactic dark matter is more than 90 percent of the total mass of 'massive' galaxies. In case of least massive galaxies also, dark matter is roughly 50% of the total mass of galaxy.
11) Advanced galactic red shift data is raising doubts on well believed cosmic acceleration [37,38] and supporting constant rate of expansion [39]. Considering the Tolman test [40] for surface brightness and based on the analysis of the UV SB of luminous disk galaxies from HUDF and GALEX datasets, reaching from the local universe to z ~ 5, recently it has been shown that the surface brightness remains constant as expected in a static universe [41,42].
12) One thing is very clear that, red shift data analysis associated with cosmic rate of expansion is generating lot of confusion and controversy in assessing the correct rate of cosmic expansion. In this context, based on the data presented in Table 2, our proposed definition of red shift i.e. relations (20) and (22) can be recommended for further research.
13) Quantum cosmology point of view, Lambda cosmology needs a review at fundamental level. Our assumptions are based on 'time reversed' black holes and seem to be well connected with General theory of relativity as well as Quantum mechanics [5,6,13].
14) By counting the actual number of galaxies and considering the average mass of galaxy and with minor adjustments, our assumptions can be refined in workable way compared to Lambda model of cosmology.
15) In 2011, researchers found evidence that galaxies tend to rotate in a preferred direction. They uncovered an excess of left-handed, or counter-clockwise rotating, spirals in the part of the sky toward the north pole of the Milky Way. This study suggests that the shape of the big bang might be more complicated than the previously thought and that the early universe spun on an axis [43]. Recently, research presented at the 236th meeting of the American Astronomical Society suggests that the whole universe may be spinning. If further studies bear this out, the finding will challenge some of the fundamental assumptions of modern cosmology [44]. In this context, considering the field experts [45,46,47,48,49] advocated value of 'current cosmic angular velocity $\approx\left(10^{-13}\ \text{rad.year}^{-1}\right)$', our assumptions can be recommended for observational search.
16) When it is assumed that, current universe is a rotating white hole, there exists no scope for causal disconnection of galaxies and no scope for 'horizon' problem. Similarly, when it is assumed that, universe is a rotating white hole having a positive curvature and expanding/growing with speed of light, then 'light speed expanding space' can be called as 'Flat space'.

**Table 2. Estimation and fitting of the distances of farthest galaxies with re-defined red shift**

| Galaxy | Red shift | Standard Light travel distance (Gly) | Estimated Light travel distance (Gly) | %Error |
|---|---|---|---|---|
| GN-z11 | 11.09 | 13.39 | 13.41 | -0.15 |
| MACS1149-JD1 | 9.11 | 13.26 | 13.17 | 0.65 |
| EGSY8p7 | 8.68 | 13.23 | 13.11 | 0.91 |
| A2744 YD4 | 8.38 | 13.2 | 13.06 | 1.05 |
| EGS-zs8-1 | 7.73 | 13.13 | 12.95 | 1.41 |
| z7 GSD 3811 | 7.66 | 13.11 | 12.93 | 1.36 |
| z8_GND_5296 | 7.51 | 13.1 | 12.9 | 1.51 |
| SXDF-NB1006-2 | 7.215 | 13.17 | 12.84 | 2.5 |
| GN-108036 | 7.213 | 13.07 | 12.84 | 2.5 |
| BDF-3299 | 7.109 | 13.05 | 12.84 | 2.5 |
| A1703 zD6 | 7.014 | 13.04 | 12.84 | 2.5 |
| BDF-521 | 7.008 | 13.04 | 12.84 | 2.5 |
| G2-1408 | 6.972 | 13.03 | 12.84 | 2.5 |
| IOK-1 | 6.964 | 13.03 | 12.84 | 2.5 |

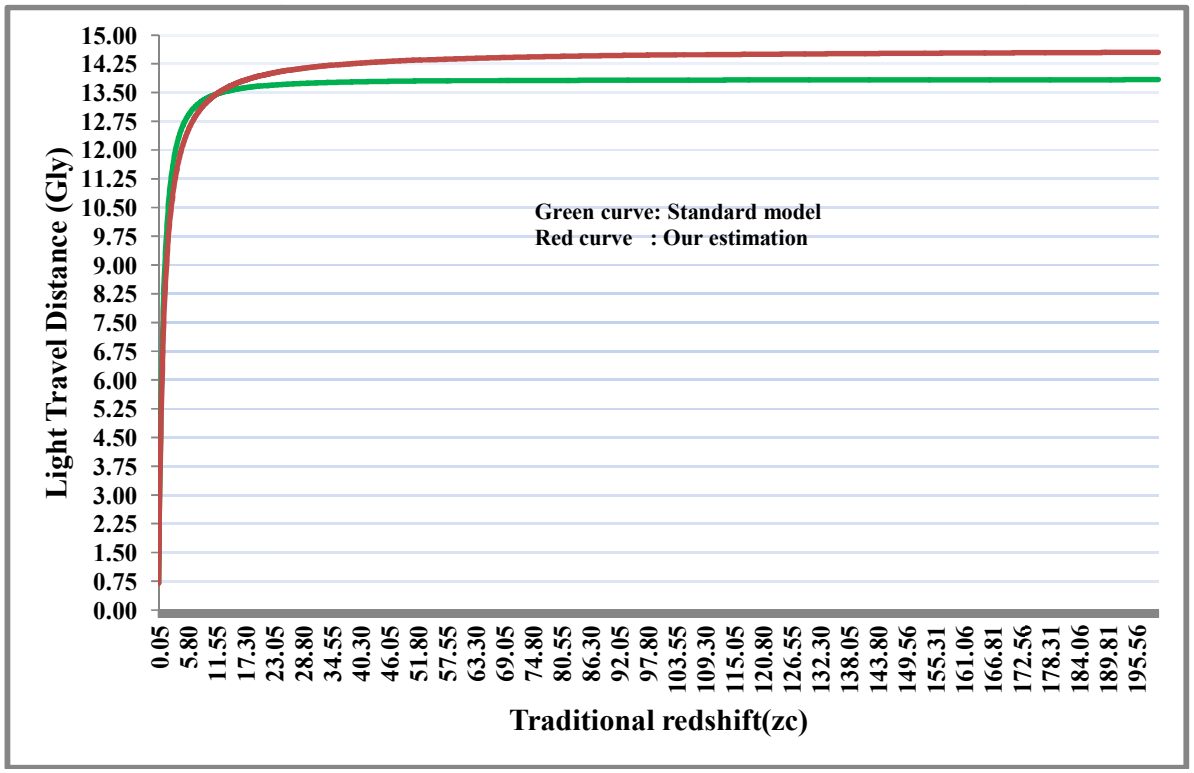


**Fig. 2. Comparison of standard and estimated light travel distances**

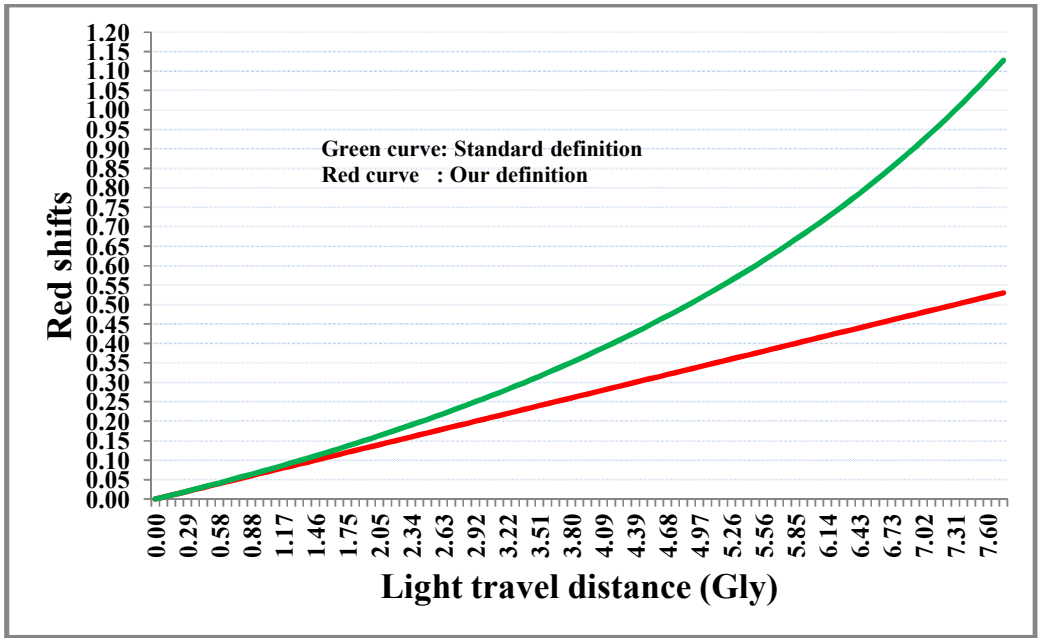


**Fig. 3. Comparison of standard and re-defined red shifts**

## 10. TO DERIVE COSMIC TEMPERATURE RELATION

At any stage of cosmic evolution and thermal expansion, with reference to Planck mass $M_{pl} \cong \sqrt{\hbar c/G}$ and by considering growing cosmic mass $M_t$ as a point particle separated by an increasing hypothetical distance equal to $r_t \cong \text{Wiens's thermal wavelength}/2\pi$, gravitational force of attraction can always be shown to be approximately equal to Einstein's force constant $\left(c^4/8\pi G\right)$. Beauty of this procedure is that in a microscopic view, it integrates Newton's law of gravitation, Einstein's cosmic force constant, Wien's displacement law, Wave-Particle relation, Special theory of relativity and Hawking's black hole temperature formula.

**Hypothesis-1**: Considering universe as a point particle of mass $M_t$ and gravitational force of attraction between the point universe and the Planck mass (the baby universe mass) is,

$$\frac{GM_tM_{Pl}}{r_t^2} \cong \frac{c^4}{8\pi G} \tag{23}$$

where $r_t$ is the hypothetical distance between $\left(M_t, M_{Pl}\right)$.

**Hypothesis-2**: Hypothetical distance between point universe and Planck mass is always equal to,

$$r_t \cong \frac{\text{Wien's thermal wave length}}{2\pi} \cong \frac{1}{2\pi}\left(\frac{2.898\times10^{-3}}{T_t}\right) \tag{24}$$

**Hypothesis-3**: Mass of universe is always equal to,

$$M_t \cong \frac{c^3}{2GH_t} \tag{25}$$

Based on these three hypotheses,

$$T_t \cong \frac{1}{\sqrt{8\pi * 4.96511423^2}} \frac{\hbar c^3}{k_B G\sqrt{M_tM_{Pl}}} \cong \frac{\hbar c^3}{24.891 k_B G\sqrt{M_tM_{Pl}}} \tag{26}$$

Comparing this result with our assumption-3, with 0.96% error,

$$T_t \cong \frac{\hbar c^3}{24.891 k_B G\sqrt{M_tM_{pl}}} \cong \frac{\hbar c^3}{8\pi k_B G\sqrt{M_tM_{pl}}} \tag{27}$$

We have,

$$\left(\sqrt{8\pi * 4.965^2} \cong 24.8914\right) \square \ (8\pi \cong 25.13274123) \tag{28}$$

For the current case, if $T_0 \cong 2.725$ K,

$$M_0 \cong \left(\frac{\hbar c^3}{24.8914 G k_B T_0\sqrt{M_{Pl}}}\right)^2 \cong \left(\frac{8.39726\times10^{26}}{2.725}\right)^2 \cong 9.496\times10^{52} \text{ kg} \tag{29}$$

$$H_0 \cong \frac{c^3}{2GM_0} \cong \left(\frac{2.01856\times10^{35}}{M_0}\right)\text{sec}^{-1} \tag{30}$$

$$\cong 2.1257\times10^{-18}\,\text{sec}^{-1} \cong 65.59\ \text{km/sec/Mpc}$$

## 11. APPLICATIONS AND MORE FUTURE PROSPECTS

We would like to appeal that,

**A) Considering the new definition of cosmic red shift,**

1) Confusion associated with basic cosmic red shift can be eliminated.
2) Galactic flat rotation speeds and their distances can be reviewed in a better way.
3) Complicated mathematical formula associated with light travel distances can be simplified.

**B) Considering Planck mass and light speed expansion**

1) Standard cosmology and basic models of quantum cosmology can be studied in a unified approach.
2) Big bang, inflation and dark energy like intellectual concepts can be explored at utmost fundamental level.
3) Complicated mathematics of general theory of relativity can be simplified to a great extent.
4) Planck scale imprints associated with current cosmic observations can be explored and thereby a correct model of cosmology can be developed with high precision.

**C) Considering the new formula associated with dark matter and visible matter**

1) Inter relation between galactic dark matter and visible matter can be refined and understood in a better way.

2) Nature of dark matter can be explored at utmost fundamental level.
3) MOND scheme can be reviewed for a better understanding.
4) Atomic and nuclear scale dark matter secrets can be understood and thereby experiments can be conducted in a result oriented approach.

**D) Considering the proposed cosmic angular velocity relation**

1) Inter relation between actual cosmic expansion rate and actual cosmic angular velocity can be understood in a better way [50].
2) Ground reality of cosmic rotation can be verified with other cosmic observations.
3) Galactic radii and angular velocity relations can be refined with respect to actual galactic mass.

## 12. CONCLUSION

When modern cosmology was in its developing stage, black hole physics was in budding stage. Now, black hole physics is in its advanced stage and modern Lambda cosmology is facing many challenges from all corners. Another important point to be noted is that, when modern cosmology is in its developing stage, subject of dark matter is mostly in its controversial stage. Considering our five assumptions, to the possible extent, subject of cosmology, galactic dark matter, galactic flat rotations curves and galactic radii can be studied in a unified manner. Considering assumptions (1) and (2), tension in estimating the value of current Hubble constant can be eliminated in a unified approach with great confidence. Clearly speaking, first two assumptions play a vital role in understanding the basic structure of the expanding universe in a very simplified quantum gravitational approach independent of currently believed classical model of Lambda cosmology. Another noteworthy point is that in reality, it is not at all possible to reach any black hole, but the idea of – 'observers residing in a time-reversed black hole (a white hole) universe that follows a scaled Hawking's temperature formula - is quite exciting and paving a way for building a realistic model of quantum cosmology. Considering assumption (3), current cosmic angular velocity can be estimated and it can be understood and realized with the works of field experts like Godel, Birch, Godlowski, Longo, Chechin, Yuri Obukhov & team and Shamir. We are working on the non equality of current Hubble parameter and current angular velocity and their backend physics. Considering assumption (4), it is possible to say that, role of dark matter in solar system and nuclear physics is negligible and it is observationally true. Considering assumption (5), galactic rotation speeds and total masses can be fitted well and there is a scope for applying it to other galaxies.

We are very confident to say that, along with our new red shift definition, our first three assumptions play a vital role in understanding the observed Universe 'as a whole'. In addition to that, big bang and inflation like non-general relativistic concepts can be relinquished with further study. Proposed red shift definition and estimated method of galactic light travel distance is very simple and clearly indicates that, currently believed matter density fractions need not be required in developing a real model of cosmology. $4^{th}$ and $5^{th}$ assumptions help in quantifying the galactic dark matter.

## 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.

## DATA AVAILABILITY STATEMENT

1) The data underlying this article pertaining to galaxies flat rotation speeds are available at http://astroweb.cwru.edu/SPARC/. It is being maintained by Federico Lelli, Stacy McGaugh and James Schombert.
2) The dataset underlying this article pertaining to farthest galaxies has been taken from https://en.wikipedia.org/wiki/List_of_the_most_distant_astronomical_objects.
3) Dataset C program underlying this article pertaining to light travel distances and red shift has been taken from http://www.atlasoftheuniverse.com/cosmodis.c. It was written by Richard Powell. To confirm our estimations, we have also considered cosmic redshift-distance

calculator written by Aaron Robotham and Joseph Dunne. Its URL is: https://cosmocalc.icrar.org/.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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