**Exploration**

# Black Hole Cosmology with Propelling Lambda Term & Hindu Cosmic Age

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## Abstract

In this article, we consider Hindu's Vedic model of cosmic age, observed visible matter density, dark matter density, Lambda term and cosmic speed of expansion. We stress the fact that, during cosmic evolution, along with the characteristic vacuum force limit ($c^4/G$), decreasing Lambda term helps in extending the cosmic black hole's Schwarzschild radius in all directions with decreasing speed. We suggest that: (1) Universe can be considered as an evolving primordial black hole;(2) Instead of 'repulsive force', conceptually Lambda term can be interlinked with 'propulsive force' and can be guessed to be directly proportional to cosmic 'thermal energy density' or cosmic 'gravitational self-energy density';(3) Cosmic black hole's speed of expansion can be shown to be directly proportional to square root of the Lambda term and inversely proportional to the Hubble parameter;(4) Cosmic acceleration and dark energy concepts can be relinquished at fundamental level;(5) Cosmic flatness can be well understood;(6) Comic 'horizon problem' can be eliminated at fundamental level; and (7) Vedic model of cosmic age can be successfully implemented in modern (black hole) cosmology.

**Keywords**: Planck scale, modern cosmology, Hindu cosmology, expansion, deceleration, light speed rotation, cosmic temperature, Lambda term, visible matter, dark matter, cosmic age, quantum gravity.

## 1. Introduction

Right from the beginning of Planck scale, if one is willing to consider the universe as a growing black hole (Antonio Alfonso-Faus2009,T. X. Zhang 2010, Popławski, N. J. 2010) with decreasing Lambda term (Varun Sahni and Alexei Starobinsky 2000), initial light speed expansion, 'very large cosmic size'(U. V. S. Seshavatharam, Lakshminarayana. S, 2015),'very large cosmic time' and continuous light speed rotation, it is certainly possible to understand the current universe. Clearly speaking, the intended purpose of inflation, current isotropic nature of cosmic microwave back ground radiation and cosmic horizon problem can be understood. Thinking in this way, in this paper, the authors developed a hypothetical toy model of cosmology in a quantum gravitational approach.

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### 1.1 Understanding the expansion of black hole universe with variable Lambda term

In our daily life generally it is observed that any animal or fruit or human beings (from birth to death) grows with closed boundaries (irregular shapes also can have a closed boundary). An apple grows like an apple. An elephant grows like an elephant. A plant grows like a plant. A human grows like a human. Throughout their life time they won't change their respective identities. These are observed facts. From these observed facts it can be suggested that "growth" or "expansion" can be possible with a closed boundary. Thinking that nature loves symmetry, in a heuristic approach in this paper, the authors assume that "throughout its life time universe is a growing black hole". Even though it is growing, at any time it is having a characteristic horizon with a closed boundary and thus it retains her identity as a black hole forever. Note that universe is an independent body. It may have its own set of laws. At any time if the universe maintains a closed boundary to have its size minimum, it must follow "Schwarzschild radius" at that time. Questions like 1) Why living creatures are growing? and 2) Why the cosmic black hole is growing? can be explored in future. In this context, the authors guess that, in cosmic evolution, the famous Lambda term can be considered as a key tool. Clearly speaking, a) During cosmic evolution, along with the characteristic vacuum force limit (W. C. Daywitt 2009) $\left(c^4/G\right)$, decreasing Lambda term helps in extending the cosmic black hole's Schwarzschild radius in all directions with decreasing speed. b) During cosmic evolution, at any stage of cosmic expansion, product of Lambda term and characteristic vacuum force limit can be considered as the vacuum energy density. c) At Planck scale, magnitude of Lambda term was very high and at present magnitude of Lambda term is very small and their ratio can be guessed to be equal to the ratio of Planck scale and current thermal energy densities. d) Instead of 'repulsive force', conceptually Lambda term can be guessed to be interlinked with cosmic 'propulsive force'.

Note that, from unification of point of view, somehow one must implement quantum gravity in elementary/advanced cosmology. But understanding/visualizing "quantum gravity" or "quantum cosmology" is really a very big task. Unless a "satellite" reaches any "friendly" black hole or one creates a "safe laboratory" micro black hole, critical issues of black hole physics cannot be resolved. Now a day's scientists strongly believe that each and every galaxy of the universe constitutes a huge central black hole. Whether the assumed galactic central black holes are by the nature, "primordial" or "gravitationally collapsed" - is still not yet clear. If it is true that, universe constitutes so many galaxies and each galaxy constitutes a primordial central black hole, then the possibility of "considering the whole universe as a gigantic primordial black hole" cannot be avoided. Clearly speaking, when the early universe was able to create a number of primordial black holes, it may not be a big problem for the whole universe to behave like a big primordial black hole. Currently believed black hole structures may be a subset of cosmic structure. With reference to the current concepts of modern cosmology, probability of 'this' to happen may be zero, but it's possibility cannot be ruled out. Thinking positively and by correlating the basics of Quantum mechanics, Newton's law of gravitation and Special and General theories of relativity- in this review paper the authors see the possibility of establishing a scale independent quantum gravitational black hole cosmology connected with current observations and past Planck scale predictions with reference to vast cosmic size and large cosmic age.

### 1.2 Hindu model of cosmic age

The Hindu Cosmology (HC) and timeline is the closest to modern scientific timelines and even more which might indicate that the Big Bang is not the beginning of everything, but just the start of the present cycle preceded by an infinite number of universes and to be followed by another infinite number of universes. The puranic view asserts that the universe is created, destroyed, and re-created in an eternally repetitive series of cycles.

In Hindu cosmology, the universe endures for about List of numbers in Hindu scriptures 4,320,000,000 years (one day of Brahma, the creator or "'Kalpa" and is then destroyed. At this point, Brahma rests for one night, just as long as the day. This process, named "pralaya" literally "especial dissolution" in Sanskrit, commonly translated as "'Cataclysm", repeats for 100 Brahma years (311 Trillion, 40 Billion Human Years) that represents station of Brahman as the creator. In current occurrence of Universe, we are believed to be in the 51st year of the present Brahma and so about 156 trillion years have elapsed since he was born as Brahma. After Brahma's "death", it is necessary that another 100 Brahma years (311 Trillion, 40 Billion Years) pass until a new Brahma is born and the whole creation begins anew. This process is repeated again and again, forever. Yash P. Aggarwal says (Yash P. Aggarwal, 2011):

A) The late astrophysicist Carl Sagan (1980) noted that "the Hindu religion is the only one of the world's great faiths dedicated to the idea that the Cosmos itself undergoes an immense, indeed an infinite, number of births and deaths. It is the only religion in which the time cycles correspond, no doubt by accident, to those of modern scientific cosmology. Its cycles run from our ordinary day and night to a day and night of Brahma, 8.64 billion years long, longer than the age of the Earth or the Sun and about half the time since the Big Bang. And there are much longer time scales still."
B) Ancient Hindu Texts indicate that cosmic processes are driven by two cycles: a Primary cycle possibly some 311 trillion years long that begins with the formation of the universe and ends with its dissolution and regeneration for a new cycle; and a Secondary cycle of 8.64 + 0.12 billion (Gy) years that begins with the formation of an Earth-like planet that supports life, or by extension the formation of a Solar system, its demise, and its rebirth. Using the history of the secondary cycles described in the Texts we deduce: 1) that our universe is at least, but not much older than 13.2 $\pm$ 0.15 Gy, in excellent agreement with current scientific data; 2) that primeval planets formed within less than a billion years of the beginnings of the universe, in agreement with the observations of NASA's Hubble Space Telescope; and 3) show that the Texts predict the demise of the Earth in the next 4.2 Gy and describe the nature and sequence of events leading to its incineration that are remarkably similar to those inferred from current models of Solar evolution. The Secondary cycle and its history implies: 1) that our Solar System is the successor to a primeval parent that formed < 0.7 Gy after the dawn of the universe; 2) that the Solar system has the capacity to essentially replicate itself approximately every 8.64 Gy; and 3) that human life may have existed on an Earth-like planet about 8.7 Gy ago. These results and implications, covering 18 Gy from the inception of the

universe to the demise of the Earth, are independent of any and all scientific theories and religious speculation concerning the origins of the universe or how stars and planets formed; nor do they rest upon any uncertain interpretations of the Texts. Therefore, the cosmic cycles of Hindu cosmology (HC) are not products of fanciful imagination of ancient Hindus, but most probably have scientific underpinnings. The cyclic universe of HC fits well with the Cyclic Model of Steinhardt and Turok (2002, 2004); and the Sun's capacity to replicate itself/planets can be explained in terms of the Solar Nebular Model and the evolution of the Sun through the red giant phase.

### 1.3 Current status of Modern cosmology and Black hole cosmology

In the recently published review paper, the authors made a serious attempt to fit the Hindu's Vedic model of cosmic age (U. V. S. Seshavatharam, Lakshminarayana. S 2015). With reference to Hindu model of cosmology (Ebenezer Burgess 1860, Kedar Nath Shukla 2014), age of the current universe is around 158.7 trillion years and total cosmic age is 311.4 trillion years. By considering assumption 5, in the most scientific way, the authors well fitted the current age of the universe with a value of 310 trillion years. In this review paper, by fitting the currently believed visible matter density and dark matter density (section-6), the authors strengthened and established the basics of Vedic model of cosmology. Considering the idea of 'initial light speed expansion with very slow reduction in cosmic expansion speed', by this time it is possible to show that, current universe is expanding with a speed of c/146 with very minute deceleration. It may be noted that, size being very large (i.e.146 times of Hubble radius) if current universe is very slowly decelerating, then it apparently resembles 'uniform rate' of expansion and this proposal can be compared with the recent type- Ia super novae observational conclusions (Nielsen. J.T et al 2015).

Very recently, by vigorously analyzing the super novae type Ia data, Nielsen. J.T et al, in a paper posted in arXiv on 3rd June 2015 suggest that, at present universe seems to be expanding at constant rate (Jun-Jie Wei et al 2015**,** F. Melia and R. S. Maier 2013) and evidence for cosmic acceleration is only marginal. In 2013, Abhas Mithra suggested that, the currently believed "Cosmic acceleration" could be an artifact of in homogeneity (A. Mitra, 2013, A. Mitra et al 2013). In 2011, Paul J. Steinhardt, one of the creators of the inflation theory, suggested against to "Inflation" (Steinhardt, P.J 2011). These published papers seriously cast doubt on the basics and advanced concepts of modern cosmology. From unification point of view S.W. Hawking expected quantum cosmology (S.W. Hawking 1987). By following the Schwarzschild formula (W.M. Stuckey 1994) and other basic and reasonable assumptions, our recently published paper (Tatum, E. T et al 2015) titled with "The basics of flat space cosmology" discounts the need for dark energy (Peebles, P. J et al 2003), the theory of cosmic inflation (Guth, A.H 1997, 1981) and Horizon problem entirely.

## 2. About cosmic rotation and quantum gravity

It is not a surprise to say that, 'nature loves symmetry'. All the celestial objects are found to be rotating. If universe is 'really an expanding sphere', then it is very natural to have some angular

momentum (Sivaram, C and Arun 2012). In that case, it is absolutely wrong to say that, "subject of cosmology can be developed and understood without cosmic rotation". If universe is 'really not rotating', it is also absolutely wrong to say that, "Subject of cosmology can be developed and understood with cosmic rotation". Since 1920 cosmologists are trying to understand the observable universe, in all the possible versions. The very important point to be noted is that, subject of cosmology is mostly subjected to very long range cosmological observations and are beyond the scope of confirmation. As universe is vast, time to time observations are indicating different set of results and are again subjected to future observations. By going through the history of observational cosmology one can understand this. It's very surprising to say that, recent observations indicate that our galaxy size is 50% larger than we believe (Yan Xu et al 2015). It is well believed that our universe constitutes so many large galaxies. If so, one cannot make a clear cut comment on the current size of the universe. In this paper, the authors would like to stress the fact that, 'with light speed rotation' qualitatively 'Hubble parameter' and 'angular velocity' both can be shown to be secondary physical constants and their individual roles can be shown to be similar.

In a heuristic approach, with reference to 'conservation of energy', 'initial light speed expansion', 'continuous light speed rotation', 'Kerr-Schwarzschild radius', 'constancy of centripetal force', Planck scale', 'quantum gravity' and Hindu model of cosmic age in this paper the authors made an attempt to develop a unified model of spherical cosmology with very slow deceleration, angular velocity, temperature, redshift and large cosmic age.

### 2.1 Cosmic rotation

In their recently published paper the authors proposed that, right from the beginning of Planck scale, universe is translating with light speed with a radius of c/H. If so, it is reasonable and natural to guess that, at every stage of cosmic expansion, for the expanding cosmic sphere, there exists certain angular velocity. By considering conservation of force, it is also reasonable to guess that, cosmic angular velocity is inversely proportional to cosmic size. With reference to Planck mass, at the beginning of comic evolution, angular velocity was very high and was equal to the Hubble parameter associated with Planck mass. Similarly for the current observable universe, angular velocity is equal to the current Hubble parameter. The main consequence of this proposal is that, right from the beginning of cosmic evolution, universe rotates with light speed. Note that according to Michael Longo (Michael Longo 2011) the universe has a net angular momentum and was born in a spin. Whittaker says (E.T. Whittaker 1945):"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". Yuri N. Obukhov(Yuri N. Obukhov 2000) 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".

If it is assumed that, universe is a black hole, it is quite natural to guess 'cosmic rotation'. Recent observations clearly indicate the possibility of 'light speed' spinning black holes (R. C. Reis et al. 2014). If a black hole of mass $10^{40}$ kg is able to rotate at light speed, then certainly it is possible to guess 'light speed rotation' at Planck scale also. Thus for the entire cosmic evolution, it is possible to have "light speed rotation"

### 2.2 Quantum gravity

In general, a unified branch of physics that connects general theory of relativity and quantum mechanics can be called as "quantum gravity". Clearly speaking, quantum gravity must show deep inner meaning at fundamental level for all possible energy scales. In this context, L.A. Glinka says - "Quantum gravity is one of the fundamental problems of modern theoretical physics. In spite of the significant efforts and various approaches, we are still very far of understanding the role of quantized gravitational fields in physical phenomena at high energies". To understand the advanced concepts of quantum gravity readers may refer L.A. Glinka's interesting paper (L. A. Glinka 2010). Note that Glinka's words clearly indicate the current uncertain status of quantum gravity. 'Quantum cosmology' is another hot topic in current theoretical physics connected with the Planck scale and the expanding universe. Note that quantum cosmology attempts to explain those predictions related to the first phases of the early universe and also attempts to explain the current low energy scale observations of classical cosmology. For a full description of this new subject readers may refer the lecture notes by Martin Bojowald(Martin Bojowald 2011).

## 3. Five unified, workable and simplified assumptions

From the Planck scale to the scale of our observable universe and with reference to Hindu cosmic age, five workable and simple assumptions can be expressed as follows:

**Assumption1**: Right from the beginning of Planck scale, universe is rotating with light speed from and about the cosmic center. (But not from/about the Earth).
**Comment1:** If it is assumed that, universe is a black hole, then there must be a center somewhere in the observable universe. It may also be noted that, without 'speed of light' there is no independent existence to Planck scale and without Planck scale there is no independent existence to physics and cosmology. In this paper, the authors are trying to give a heuristic cosmological significance to 'speed of light'.

**Assumption2**: At any stage of cosmic evolution, ratio of Hubble parameter and angular velocity can be expressed as,

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

where $H_t$ is the Hubble parameter and $\omega_{pl}$ is the Planck scale angular velocity.

**Comment2**: This assumption is new, ad-hoc and proposed with reference to the currently recommended magnitudes of Hubble parameter and CMBR temperature. Note that, in the earlier published paper, the authors assumed that, at any stage of cosmic expansion, Hubble parameter and cosmic angular velocity are equal in magnitude. It may be true that, ratio of angular velocity and Hubble parameter is model dependent. Interested readers may assume a different ratio of Hubble parameter and angular velocity and may try for fitting the current Hubble parameter and cosmic microwave back ground temperature.

**Assumption-3**: Right from the beginning of Planck scale, cosmic size follows the relation,

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

where $R_t$, $M_t$ and $\omega_t$ represent the radius, mass and angular velocity of the universe at time $t$ respectively.

**Comment3:** This assumption is not new and can be seen in physics literature related with cosmology. With assumptions 1, 2 and 3 cosmic flatness and horizon problems can be understood. Now it is very simple to show that, at any stage of cosmic expansion, magnitude of centripetal force is of the order of $M_t\left(c^2/R_t\right) \cong M_t c\omega_t \cong \left(c^4/G\right)$. Clearly speaking, at different stages of cosmic expansion, $M_1\left(c^2/R_1\right) \cong M_2\left(c^2/R_2\right) \cong M_3\left(c^2/R_3\right) \cong \left(c^4/G\right)$. Thinking in this way, at any stage of cosmic expansion, angular momentum can be shown to be $L_t \approx M_t c R_t \approx \left(GM_t^2/c\right) \approx \left(M_t/M_{pl}\right)^2 \hbar \approx \left(R_t/R_{pl}\right)^2 \hbar$. Thus in this paper, the authors made an attempt to give priority to "constant centripetal force" or "conservation of centripetal force" rather than "conservation of angular momentum".

**Assumption4**: Right from the beginning of Planck scale, at any stage of cosmic expansion, cosmic gravitational potential energy and total thermal energy are equal in magnitude and can be expressed as follows.

$$\frac{3}{5}\frac{GM_t^2}{R_t} \cong aT_t^4\left[\frac{4\pi}{3}\left(R_t^3\right)\right]. \tag{3}$$

**Comment4:** This assumption is new and can be given some consideration for in depth analysis with respect to energy conservation in the expanding universe.

**Assumption-5**: At any stage of cosmic expansion, 'light speed' play a key role in the following way.

$$\left.\begin{aligned} &R_t \cong \sqrt{(ct)\left(c/H_t\right)} \cong c\sqrt{t/H_t} \\ &\rightarrow R_t/c \cong 1/\omega_t \cong \sqrt{t/H_t} \text{ and} \\ &t \cong \frac{H_t}{\omega_t^2} \cong \left[1+\ln\left(\frac{\omega_{pl}}{\omega t}\right)\right]\left(\frac{1}{\omega_t}\right) \end{aligned}\right\} \tag{4}$$

where $t$ is the cosmic age, $H_t$ is the Hubble parameter and $\omega_t$ is the angular velocity.

**Comment5:** With this assumption, Hindu's model of cosmic age can be fitted with a factor of $1/2$. Another interesting point is that, at any stage of cosmic expansion, expansion speed can be expressed as $v_t \cong \frac{R_t}{t} \cong \left\{1+\ln\left(\frac{\omega_{pl}}{\omega_t}\right)\right\}^{-1} c \cong \left(\frac{\omega_t}{H_t}\right)c$ and seems to be decreasing very slowly by the factor $\left\{1+\ln\left(\frac{\omega_{pl}}{\omega_t}\right)\right\}$. At present, it seems that $v_0 \cong \frac{R_0}{t_0} \cong \left\{1+\ln\left(\frac{\omega_{pl}}{\omega_0}\right)\right\}^{-1} c \cong c/146$. Hence it is pos-

sible to say that, at present, universe is decelerating with a velocity of $v_0 \cong c/146$ and rate of deceleration is very small and seems to be beyond the scope of current observations. See table 1. Data of table-1 seems to support the recent Super novae observational conclusions of uniform rate of expansion. This proposal can also be confirmed from the isotropic nature of current CMBR temperature.

## 4. To connect the cosmic physical parameters

Following these assumptions, Planck scale Hubble parameter and angular velocity both can be assumed to be equal in magnitude and can be expressed as follows.

$$H_{pl} \cong \omega_{pl} \cong \frac{c^3}{GM_{pl}} \cong \frac{c}{R_{pl}} \cong 1.85492\times10^{43} \text{ rad.sec}^{-1} \tag{5}$$

where $R_{pl} \cong GM_{pl}/c^2 \cong \sqrt{G\hbar/c^3} \cong 1.6162\times10^{-35}$ m is the assumed radius connected with Planck mass.

Planck scale temperature can be expressed as

$$T_{pl} \cong \left(\frac{9\omega_{pl}^2 c^2}{20\pi G a}\right)^{\frac{1}{4}} \cong \left(\frac{9H_{pl}^2 c^2}{20\pi G a}\right)^{\frac{1}{4}} \cong 9.67792\times10^{31} \text{ K} \tag{6}$$

At any stage of cosmic expansion, if cosmic temperature is known,

**Step1**: Angular velocity can be estimated with the following relation.

$$aT_t^4 \cong \frac{9c^2\omega_t^2}{20\pi G} \text{ and } \omega_t \cong \sqrt{\frac{20\pi G a T_t^4}{9c^2}} \tag{7}$$

**Step2**: Hubble parameter can be estimated with the following relation.

$$H_t \cong \omega_t \left\{1+\ln\left(\frac{\omega_{pl}}{\omega_t}\right)\right\} \tag{8}$$

It is having the following key applications in cosmology.

1. Current CMBR temperature can be fitted approximately.
2. A very simple relation for CMBR redshift can be developed. See section-9.
3. Standard cosmology's predicted redshift of 1100 connected with recombination temperature of 3000 K can be fitted very easily.

4. At every stage of expansion, qualitatively Hawking's 'black hole temperature formula' like relation can be obtained. See relation (9).
5. General relativity, Quantum mechanics, Planck scale high temperatures, current & future low temperatures can be studied in a unified manner and a unified model of scale independent quantum gravity/cosmology can be developed at fundamental level.

With reference to Planck mass and by splitting the radiation constant, if cosmic angular velocity is known, cosmic temperature can be estimated with the following relation.

$$\left.\begin{aligned} T_t &\cong \left(\frac{9\omega_t^2 c^2}{20\pi G a}\right)^{1/4} \cong \left(\frac{135}{20\pi^3}\right)^{1/4}\left(\frac{\hbar c^3}{k_B G\sqrt{M_t M_{pl}}}\right) \\ &\cong \left(\frac{135}{20\pi^3}\right)^{1/4}\left(\frac{M_t}{M_{pl}}\right)^{1/2}\left(\frac{\hbar c^3}{k_B G M_t}\right) \end{aligned}\right\} \quad (9)$$

In this relation, the expression, $\left(\frac{\hbar c^3}{k_B G M_t}\right)$ qualitatively can be compared with the famous Hawking's Black hole temperature formula (Hawking, S.W 1975). Considering this relation, quantum mechanics, general theory of relativity and Planck scale can be studied in a unified manner and quantum cosmology can be put into main stream cosmological observations. With reference to Wien's displacement law, if $(\lambda_m)_t$ is the wavelength of cosmic temperature, it is possible to show that,

$$\left.\begin{aligned} (\lambda_m)_t &\cong \left(\frac{2\pi}{x}\right)\left(\frac{20\pi^3}{135}\right)^{1/4}\left(\frac{G\sqrt{M_t M_{pl}}}{c^2}\right) \\ &\cong 1.852623144\left(\frac{G\sqrt{M_t M_{pl}}}{c^2}\right) \end{aligned}\right\} \quad (10)$$

$$\left\{\begin{aligned} &\text{where, } x \cong 4.96511423, \text{ and} \\ &\left(\frac{2\pi}{x}\right)\left(\frac{20\pi^3}{135}\right)^{1/4} \cong 1.852623144 \end{aligned}\right.$$

This is really a very nice interpretation. In addition, it seems to provide a strong link in connecting General theory of relativity and Quantum mechanics.

## 5. The characteristic equations of current universe in this unified model of cosmology

As per the 2015 Planck data (P.A.R. Ade et al, Fixsen, D.J. 2009) the current value of the Hubble parameter is reported to be:

Planck TT+low P: $(67.31\pm0.96)$ km/sec/Mpc;
Planck TE+low P: $(67.73\pm0.92)$km/sec/Mpc;
Planck TT,TE,EE+low P: $(67.7\pm0.66)$km/sec/Mpc;

*As per the* 2015 *Planck data, the current* $T_0$ *is* :
Planck TT + lowP + BAO: $(2.722\pm0.027)$ K,
Planck TT; TE; EE + low P + BAO: $(2.718\pm0.021)$K
and upper limit seems to be $2.722+0.027\cong 2.749$ K.

**Step-1**: With reference to the upper limit of recommended current angular velocity can be estimated as follows:

$$\omega_0 \cong \sqrt{\frac{20\pi G a T_0^4}{9c^2}} \cong 1.496613\times10^{-20} \text{ rad/sec} \tag{11}$$

**Step-2**: Current Hubble parameter can be estimated as follows:

$$\begin{aligned} H_0 &\cong \omega_0\left\{1+\ln\left(\frac{\omega_{pl}}{\omega_0}\right)\right\} \cong 2.18921\times10^{-18} \text{ sec}^{-1} \\ &\cong 67.5524 \text{ km/sec/Mpc} \end{aligned} \tag{12}$$

Current cosmic mass and radius can be estimated as,

$$\left.\begin{aligned} M_0 &\cong \frac{R_0c^2}{G} \cong \frac{c^3}{G\omega_0} \cong 2.6976\times10^{55} \text{ kg} \\ R_0 &\cong \frac{GM_0}{c^2} \cong \frac{c}{\omega_0} \cong 2.00\times10^{28} \text{ m} \end{aligned}\right\} \tag{13}$$

The two impossible things in cosmology are: 1) Measuring the cosmic size. 2) Measuring the cosmic mass. It may be noted that, with reference to current Hubble radius, ~68% dark energy and ~32% (observable matter and dark matter) total estimated mass of current universe is $2.48\times10^{54}$ kg. This can be compared with the proposed estimate of $2.70\times10^{55}$ kg. Estimation of observable cosmic mass mainly depends on 'counting the number of 'weighing the central core mass of all the galaxies', 'counting the number of stars in all of the galaxies' and 'weighing the individual mass of stars' etc. This entire procedure is mainly based on 'observational approach' and needs so many correction factors. Two interesting points are: 1) Day by day, 'cosmic acceleration' and 'dark energy' both are losing their identity. Hence in future it may be easy to estimate the cosmic mass. With future cosmological observations and other models of cosmology, these proposed magnitudes of cosmic mass and size can be considered as the characteristic limiting magnitudes.

## 6. The characteristic equations of current cosmic matter density and dark matter density

Current visible matter density can be fitted as follows.

$$\left.\begin{aligned}\left(\rho_{v.matter}\right)_0 &\cong \left\{\left(\frac{H_0}{\omega_0}\right)\ln\left(\frac{H_0}{\omega_0}\right)\right\}\left(\frac{9\omega_0^2}{20\pi G}\right)\\ &\cong \left\{\ln\left(\frac{H_0}{\omega_0}\right)\right\}\left(\frac{9H_0\omega_0}{20\pi G}\right)\\ &\cong 3.151\times10^{-11}/c^2 \text{ J.m}^{-3} \cong 3.506\times10^{-28} \text{ kg.m}^{-3}\end{aligned}\right\} \quad (14)$$

Note that, this obtained value of the current visible matter density can be compared with the current galactic mean matter density which is being estimated by considering different galactic mass-to-light ratios and is having a very broad range (J.V.Narlikar 2002). The corresponding relation is,

$$\left(\rho_{galaxy}\right)_0 \cong 1.5\times10^{-32}\eta h_0 \text{ g.m}^{-3} \quad (15)$$

$$\text{where}\begin{cases} h_0 \cong \dfrac{H_0}{100 \text{ km/sec/Mpc}} \text{ and} \\ \eta \cong \left[(10\pm2)h_0 \text{ to } (500\pm200)h_0\right]\end{cases}$$

It may also be noted that, based on the big band nucleosynthesis, (Copi C.J et al, 1995), $\left(\rho_{baryon}\right)_0 \cong (1.7 \text{ to } 4.1)\times10^{-31}\text{g.m}^{-3}$.

To a great surprise it is noticed that, currently believed ratio of dark matter density and visible matter density is very close to the natural logarithm of the ratio of current Hubble parameter and current angular velocity. It can be expressed as follows.

$$\frac{\left(\rho_{d.matter}\right)_0}{\left(\rho_{v.matter}\right)_0} \cong \ln\left(\frac{H_0}{\omega_0}\right) \cong 4.98551 \quad (16)$$

$$\left.\begin{aligned}\left(\rho_{d.matter}\right)_0 &\cong \ln\left(\frac{H_0}{\omega_0}\right)\left(\rho_{v.matter}\right)_0\\ &\cong \left\{\left(\frac{H_0}{\omega_0}\right)\left\{\ln\left(\frac{H_0}{\omega_0}\right)\right\}^2\right\}\left(\frac{9\omega_0^2}{20\pi G}\right)\\ &\cong \left\{\ln\left(\frac{H_0}{\omega_0}\right)\right\}^2\left(\frac{9H_0\omega_0}{20\pi G}\right)\\ &\cong 1.571\times10^{-11}/c^2 \text{ J.m}^{-3} \cong 1.748\times10^{-27} \text{ kg.m}^{-3}\end{aligned}\right\} \quad (17)$$

Based on these fittings, it is possible to guess that, in the past,

$$\left(\rho_{v.matter}\right)_t \cong \left\{\left(\frac{H_t}{\omega_t}\right)\ln\left(\frac{H_t}{\omega_t}\right)\right\}\left(\frac{9\omega_t^2}{20\pi G}\right)$$
$$\cong \left\{\ln\left(\frac{H_t}{\omega_t}\right)\right\}\left(\frac{9H_t\omega_t}{20\pi G}\right) \quad (18)$$

$$\left(\rho_{d.matter}\right)_t \cong \ln\left(\frac{H_t}{\omega_t}\right)\left(\rho_{v.matter}\right)_t$$
$$\cong \left\{\left(\frac{H_t}{\omega_t}\right)\left\{\ln\left(\frac{H_t}{\omega_t}\right)\right\}^2\right\}\left(\frac{9\omega_t^2}{20\pi G}\right) \quad (19)$$
$$\cong \left\{\ln\left(\frac{H_t}{\omega_t}\right)\right\}^2\left(\frac{9H_t\omega_t}{20\pi G}\right)$$

At Planck scale, there was no visible matter content and there was no dark matter content. As universe is evolving, visible matter content and dark matter content will tend to increase.

## 7. Cosmic age

In general, cosmic age is 'model dependent' and 'cosmic size dependent'. In this proposed model, cosmic age estimation is very simple and direct. With assumption-5 and from the beginning of Planck scale, cosmic age can be estimated as follows.

$$t \cong \frac{R_t^2 H_t}{c^2} \cong \frac{H_t}{\omega_t^2} \cong \left[1+\ln\left(\frac{\omega_{pl}}{\omega_t}\right)\right]\left(\frac{1}{\omega_t}\right) \quad (20)$$

For the current case,

$$t_0 \cong \frac{H_0}{\omega_0^2} \cong \left[1+\ln\left(\frac{\omega_{pl}}{\omega_0}\right)\right]\left(\frac{1}{\omega_0}\right) \cong 9.774\times10^{21} \text{ sec} \quad (21)$$
$$\cong 309.72 \text{ TrillionYears}$$

This estimated time is matching with the Hindu model of cosmic age with a factor of 1/2 and needs further study. Note that, according to Hindu cosmology, total age of the universe is 311.4 trillion years and current cosmic age is just greater than 155.7 trillion years. From relation (13) estimated current cosmic radius is 146 times higher than the current Hubble radius and current cosmic age is $146^2$ = 21397 times higher than the currently believed cosmic age of 13.8 billion years. Note that, in this model, assumed cosmic time is a function of cosmic angular velocity and is subjected to current and future observational estimations of magnitude of cosmic angular velocity.

## Table-1: To estiamte various parameters of the expanding and rotating universe

| Assumed angular velocity (rad/sec) | Estimated Hubble parameter (1/sec) | Estimated cosmic radius (m) | Estimated cosmic mass (kg) | Estimated cosmic temperature (K) | Estimated cosmic age (sec) | Estimated cosmic rate of expansion (m/sec) |
|---|---|---|---|---|---|---|
| 1.49229E+42 | 5.25304E+42 | 2.00894E-34 | 2.70540E-07 | 2.74502E+31 | 2.35886E-42 | 8.51656E+07 |
| 1.49229E+41 | 8.68918E+41 | 2.00894E-33 | 2.70540E-06 | 8.68052E+30 | 3.90184E-41 | 5.14869E+07 |
| 1.49229E+40 | 1.21253E+41 | 2.00894E-32 | 2.70540E-05 | 2.74502E+30 | 5.44483E-40 | 3.68962E+07 |
| 1.49229E+39 | 1.55614E+40 | 2.00894E-31 | 2.70540E-04 | 8.68052E+29 | 6.98781E-39 | 2.87492E+07 |
| 1.49229E+38 | 1.89976E+39 | 2.00894E-30 | 2.70540E-03 | 2.74502E+29 | 8.53079E-38 | 2.35492E+07 |
| 1.49229E+37 | 2.24337E+38 | 2.00894E-29 | 2.70540E-02 | 8.68052E+28 | 1.00738E-36 | 1.99422E+07 |
| 1.49229E+36 | 2.58698E+37 | 2.00894E-28 | 2.70540E-01 | 2.74502E+28 | 1.16168E-35 | 1.72934E+07 |
| 1.49229E+35 | 2.93060E+36 | 2.00894E-27 | 2.70540E+00 | 8.68052E+27 | 1.31597E-34 | 1.52658E+07 |
| 1.49229E+34 | 3.27421E+35 | 2.00894E-26 | 2.70540E+01 | 2.74502E+27 | 1.47027E-33 | 1.36637E+07 |
| 1.49229E+33 | 3.61782E+34 | 2.00894E-25 | 2.70540E+02 | 8.68052E+26 | 1.62457E-32 | 1.23660E+07 |
| 1.49229E+32 | 3.96144E+33 | 2.00894E-24 | 2.70540E+03 | 2.74502E+26 | 1.77887E-31 | 1.12933E+07 |
| 1.49229E+31 | 4.30505E+32 | 2.00894E-23 | 2.70540E+04 | 8.68052E+25 | 1.93317E-30 | 1.03919E+07 |
| 1.49229E+30 | 4.64867E+31 | 2.00894E-22 | 2.70540E+05 | 2.74502E+25 | 2.08747E-29 | 9.62381E+06 |
| 1.49229E+29 | 4.99228E+30 | 2.00894E-21 | 2.70540E+06 | 8.68052E+24 | 2.24176E-28 | 8.96141E+06 |
| 1.49229E+28 | 5.33589E+29 | 2.00894E-20 | 2.70540E+07 | 2.74502E+24 | 2.39606E-27 | 8.38432E+06 |
| 1.49229E+27 | 5.67951E+28 | 2.00894E-19 | 2.70540E+08 | 8.68052E+23 | 2.55036E-26 | 7.87707E+06 |
| 1.49229E+26 | 6.02312E+27 | 2.00894E-18 | 2.70540E+09 | 2.74502E+23 | 2.70466E-25 | 7.42769E+06 |
| 1.49229E+25 | 6.36673E+26 | 2.00894E-17 | 2.70540E+10 | 8.68052E+22 | 2.85896E-24 | 7.02682E+06 |
| 1.49229E+24 | 6.71035E+25 | 2.00894E-16 | 2.70540E+11 | 2.74502E+22 | 3.01326E-23 | 6.66700E+06 |
| 1.49229E+23 | 7.05396E+24 | 2.00894E-15 | 2.70540E+12 | 8.68052E+21 | 3.16755E-22 | 6.34223E+06 |
| 1.49229E+22 | 7.39757E+23 | 2.00894E-14 | 2.70540E+13 | 2.74502E+21 | 3.32185E-21 | 6.04764E+06 |
| 1.49229E+21 | 7.74119E+22 | 2.00894E-13 | 2.70540E+14 | 8.68052E+20 | 3.47615E-20 | 5.77920E+06 |
| 1.49229E+20 | 8.08480E+21 | 2.00894E-12 | 2.70540E+15 | 2.74502E+20 | 3.63045E-19 | 5.53358E+06 |
| 1.49229E+19 | 8.42841E+20 | 2.00894E-11 | 2.70540E+16 | 8.68052E+19 | 3.78475E-18 | 5.30798E+06 |
| 1.49229E+18 | 8.77203E+19 | 2.00894E-10 | 2.70540E+17 | 2.74502E+19 | 3.93905E-17 | 5.10006E+06 |
| 1.49229E+17 | 9.11564E+18 | 2.00894E-09 | 2.70540E+18 | 8.68052E+18 | 4.09334E-16 | 4.90781E+06 |
| 1.49229E+16 | 9.45925E+17 | 2.00894E-08 | 2.70540E+19 | 2.74502E+18 | 4.24764E-15 | 4.72953E+06 |
| 1.49229E+15 | 9.80287E+16 | 2.00894E-07 | 2.70540E+20 | 8.68052E+17 | 4.40194E-14 | 4.56375E+06 |
| 1.49229E+14 | 1.01465E+16 | 2.00894E-06 | 2.70540E+21 | 2.74502E+17 | 4.55624E-13 | 4.40920E+06 |
| 1.49229E+13 | 1.04901E+15 | 2.00894E-05 | 2.70540E+22 | 8.68052E+16 | 4.71054E-12 | 4.26477E+06 |
| 1.49229E+12 | 1.08337E+14 | 2.00894E-04 | 2.70540E+23 | 2.74502E+16 | 4.86484E-11 | 4.12951E+06 |
| 1.49229E+11 | 1.11773E+13 | 2.00894E-03 | 2.70540E+24 | 8.68052E+15 | 5.01913E-10 | 4.00256E+06 |
| 1.49229E+10 | 1.15209E+12 | 2.00894E-02 | 2.70540E+25 | 2.74502E+15 | 5.17343E-09 | 3.88318E+06 |
| 1.49229E+09 | 1.18645E+11 | 2.00894E-01 | 2.70540E+26 | 8.68052E+14 | 5.32773E-08 | 3.77072E+06 |
| 1.49229E+08 | 1.22082E+10 | 2.00894E+00 | 2.70540E+27 | 2.74502E+14 | 5.48203E-07 | 3.66459E+06 |
| 1.49229E+07 | 1.25518E+09 | 2.00894E+01 | 2.70540E+28 | 8.68052E+13 | 5.63633E-06 | 3.56427E+06 |
| 1.49229E+06 | 1.28954E+08 | 2.00894E+02 | 2.70540E+29 | 2.74502E+13 | 5.79063E-05 | 3.46929E+06 |
| 1.49229E+05 | 1.32390E+07 | 2.00894E+03 | 2.70540E+30 | 8.68052E+12 | 5.94492E-04 | 3.37925E+06 |
| 1.49229E+04 | 1.35826E+06 | 2.00894E+04 | 2.70540E+31 | 2.74502E+12 | 6.09922E-03 | 3.29376E+06 |
| 1.49229E+03 | 1.39262E+05 | 2.00894E+05 | 2.70540E+32 | 8.68052E+11 | 6.25352E-02 | 3.21249E+06 |
| 1.49229E+02 | 1.42698E+04 | 2.00894E+06 | 2.70540E+33 | 2.74502E+11 | 6.40782E-01 | 3.13513E+06 |
| 1.49229E+01 | 1.46135E+03 | 2.00894E+07 | 2.70540E+34 | 8.68052E+10 | 6.56212E+00 | 3.06142E+06 |
| 1.49229E+00 | 1.49571E+02 | 2.00894E+08 | 2.70540E+35 | 2.74502E+10 | 6.71642E+01 | 2.99108E+06 |
| 1.49229E-01 | 1.53007E+01 | 2.00894E+09 | 2.70540E+36 | 8.68052E+09 | 6.87072E+02 | 2.92391E+06 |
| 1.49229E-02 | 1.56443E+00 | 2.00894E+10 | 2.70540E+37 | 2.74502E+09 | 7.02501E+03 | 2.85969E+06 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 1.49229E-03 | 1.59879E-01 | 2.00894E+11 | 2.70540E+38 | 8.68052E+08 | 7.17931E+04 | 2.79823E+06 |
| 1.49229E-04 | 1.63315E-02 | 2.00894E+12 | 2.70540E+39 | 2.74502E+08 | 7.33361E+05 | 2.73936E+06 |
| 1.49229E-05 | 1.66751E-03 | 2.00894E+13 | 2.70540E+40 | 8.68052E+07 | 7.48791E+06 | 2.68291E+06 |
| 1.49229E-06 | 1.70187E-04 | 2.00894E+14 | 2.70540E+41 | 2.74502E+07 | 7.64221E+07 | 2.62874E+06 |
| 1.49229E-07 | 1.73624E-05 | 2.00894E+15 | 2.70540E+42 | 8.68052E+06 | 7.79651E+08 | 2.57671E+06 |
| 1.49229E-08 | 1.77060E-06 | 2.00894E+16 | 2.70540E+43 | 2.74502E+06 | 7.95080E+09 | 2.52671E+06 |
| 1.49229E-09 | 1.80496E-07 | 2.00894E+17 | 2.70540E+44 | 8.68052E+05 | 8.10510E+10 | 2.47861E+06 |
| 1.49229E-10 | 1.83932E-08 | 2.00894E+18 | 2.70540E+45 | 2.74502E+05 | 8.25940E+11 | 2.43230E+06 |
| 1.49229E-11 | 1.87368E-09 | 2.00894E+19 | 2.70540E+46 | 8.68052E+04 | 8.41370E+12 | 2.38770E+06 |
| 1.49229E-12 | 1.90804E-10 | 2.00894E+20 | 2.70540E+47 | 2.74502E+04 | 8.56800E+13 | 2.34470E+06 |
| 1.49229E-13 | 1.94240E-11 | 2.00894E+21 | 2.70540E+48 | 8.68052E+03 | 8.72230E+14 | 2.30322E+06 |
| 1.49229E-14 | 1.97677E-12 | 2.00894E+22 | 2.70540E+49 | 2.74502E+03 | 8.87659E+15 | 2.26318E+06 |
| 1.49229E-15 | 2.01113E-13 | 2.00894E+23 | 2.70540E+50 | 8.68052E+02 | 9.03089E+16 | 2.22452E+06 |
| 1.49229E-16 | 2.04549E-14 | 2.00894E+24 | 2.70540E+51 | 2.74502E+02 | 9.18519E+17 | 2.18715E+06 |
| 1.49229E-17 | 2.07985E-15 | 2.00894E+25 | 2.70540E+52 | 8.68052E+01 | 9.33949E+18 | 2.15101E+06 |
| 1.49229E-18 | 2.11421E-16 | 2.00894E+26 | 2.70540E+53 | 2.74502E+01 | 9.49379E+19 | 2.11605E+06 |
| 1.49229E-19 | 2.14857E-17 | 2.00894E+27 | 2.70540E+54 | 8.68052E+00 | 9.64809E+20 | 2.08221E+06 |
| **1.49229E-20** | **2.18293E-18** | **2.00894E+28** | **2.70540E+55** | **2.74502E+00** | **9.80238E+21** | **2.04944E+06** |

## 8. Practical applications of current angular velocity in this unified model

### A. Galactic revolving speed:

For the current light speed rotating cosmic model, on the equatorial plane, galactic revolving speed can be expressed as,

$$\left(v_g\right)_{rev} \cong r_g \omega_0 \leq c \tag{22}$$

Here, $r_g$ and $\left(v_g\right)_{rev}$ represent the galactic distance from the cosmic center and galactic revolving speed corresponding to the cosmic angular velocity, respectively. The important point to be noted is that, even though $\frac{\left(v_g\right)_{rev}}{c}$ is always less than 1, the proposed velocity refers to galactic "revolution speed" about the cosmic center and the proposed distance refers to galaxy distance from the cosmic center. Importantly, actual galactic "revolving speeds" have never been confirmed by any direct cosmological observations. This is for further study.

### B. Galactic receding speed:

In modeling the current expanding universe, on the equatorial plane, galactic receding speed can be expressed as follows.

$$\left(v_g\right)_{rec} \cong \left(\frac{r_g}{R_0}\right) v_0 \leq v_0 \tag{23}$$

In Hubble's law (Hubble, E.P. 1929, 1947), velocity refers to galactic "receding speed" and distance refers to "distance between galaxy and observer." Thus *Hubble's law appears to be a natural physical consequence in this model.*

### C. Galactic centripetal acceleration:

1) For any revolving galaxy, galactic centripetal acceleration can be expressed as:

$$a_g \cong \omega_0 \left(v_g\right)_{rev} \cong r_g \omega_0^2 \tag{24}$$

2) For any satellite that is assumed to be revolving at a distance $r_{satellite}$ from the cosmic center, centripetal acceleration can be expressed as:

$$a_{satellite} \cong \omega_0 \left(v_g\right)_{rev} \cong r_{satellite} \omega_0^2 \tag{25}$$

Based on the above applications, and by measuring actual galactic "revolving speeds", the current cosmic centripetal acceleration can be estimated.

### D. Galactic rotational curves:

The current dominant paradigm is that galaxies are embedded in halos of cold dark matter (CDM), made of non-baryonic weakly-interacting massive particles. However, an alternative way to explain the observed rotation curves of galaxies is the postulate that, for gravitational accelerations below a certain value $a_0 \cong (1.2 \pm 0.3) \times 10^{-10}\ \ m.\sec^{-2}$ ,the true gravitational field strength $g$ approaches $\sqrt{g_N\, g}$ , where $g_N$ is the usual Newtonian gravitational field strength (as calculated from the observed distribution of visible matter). This paradigm is known as modified Newtonian dynamics (MOND). Here, $a_0 \cong (1.2 \pm 0.3) \times 10^{-10}\ \ m.\sec^{-2}$ . In the light speed rotating cosmic model, by considering the galactic revolving speed $\left(v_g\right)_{rev}$ about the cosmic center, the magnitude of galactic centripetal acceleration can be assumed to vary as:

$$a_g \cong \omega_0 \left(v_g\right)_{rev} \cong r_g \omega_0^2 \tag{26}$$

Where $r_g$ is the distance between galaxy and the cosmic center. Now rotational speed of a star in any galaxy can be represented as follows:

$$\begin{aligned} \left(v_{star}\right)_{rev} &\propto \sqrt[4]{GM_g \omega_0 \left(v_g\right)_{rev}} \\ &\propto \sqrt[4]{GM_g r_g \omega_0^2} \end{aligned} \tag{27}$$

$M_g$ is the mass of the galaxy. With an assumed universal proportionality ratio of 1, and by knowing the galactic mass and actual revolving speeds of galactic stars, galactic revolving speed and galactic distance from the cosmic center can be approximated in the following way:

$$\left.\begin{aligned} \left(v_g\right)_{rev} &\cong \frac{\left(v_{star}\right)_{rev}^4}{GM_g\omega_0} \text{ and} \\ r_g &\cong \frac{\left(v_g\right)_{rev}}{\omega_0} \cong \frac{\left(v_{star}\right)_{rev}^4}{GM_g\omega_0^2} \end{aligned}\right\} \tag{28}$$

By knowing our mother galactic mass and rotational curves, our galactic distance from the cosmic center can be approximated. By considering the different model-dependent proportionality ratios, and correlating all of the data, finally the correct magnitude of the proportionality ratio can be fitted. This is for further study.

## 9. Model equation of cosmic non-linear redshift

In this section, in a semi-empirical approach, the authors propose a very simple model equation for observed and predicted cosmic redshifts, including galactic and CMBR redshifts. These are for further research and analysis. With reference to the proposed assumptions,

$$\left\{1+\ln\left(\frac{\omega_{pl}}{\omega_0}\right)\right\} \cong \left\{1+\ln\left(\frac{R_t}{R_{pl}}\right)\right\} \tag{29}$$

Thus at any stage of cosmic expansion in the past,

$$\left\{1+\ln\left(\frac{\omega_{pl}}{\omega_t}\right)\right\} \cong \left\{1+\ln\left(\frac{R_t}{R_{pl}}\right)\right\} \tag{30}$$

Based on this relation, one particularly simple model equation under current study is:

$$Z \cong \sqrt{\frac{\omega_t}{\omega_0}-1} \cong \sqrt{\frac{R_0}{R_t}-1} \cong \sqrt{\frac{GM_0}{c^2R_t}-1} \tag{31}$$

$$\text{where } \omega_t > \omega_0, R_t < R_0, \text{ and } M_0 \cong c^3/G\omega_0.$$

Where $\omega_0$ and $\omega_t$ represent current and past cosmic angular velocity respectively. Similarly $R_0$ and $R_t$ represent current and past decreasing cosmic radii, respectively. Thus in this model, by knowing or guessing the galactic redshift, cosmic angular velocity can be estimated. With reference to cosmic center and by following relation (31) and Minkowski's relativistic Doppler shift formula, galactic redshift (connected with simultaneous cosmic expansion speed and light speed

rotation) may be considered for further study and analysis. With reference to the proposed assumptions, relation (31) can be obtained in the following semi-empirical approach. Let,

$$\left[1+\ln\left(\frac{R_0}{R_{pl}}\right)\right]\cong\Upsilon_0 \text{ and } \left[1+\ln\left(\frac{R_t}{R_{pl}}\right)\right]\cong\Upsilon_t \tag{32}$$

$$\left.\begin{aligned} Z &\cong \sqrt{\exp\left(\Upsilon_0-\Upsilon_t\right)-1} \\ &\cong \sqrt{\exp\left\{\left[\left[1+\ln\left(\frac{R_0}{R_{pl}}\right)\right]-\left[1+\ln\left(\frac{R_t}{R_{pl}}\right)\right]\right]\right\}-1} \\ &\cong \sqrt{\exp\left\{\left(\ln\left(\frac{R_0}{R_{pl}}\right)-\ln\left(\frac{R_t}{R_{pl}}\right)\right)\right\}-1} \\ &\cong \sqrt{\exp\left\{\ln\left(\frac{R_0}{R_t}\right)\right\}-1} \;\cong \sqrt{\frac{R_0}{R_t}-1} \end{aligned}\right\} \tag{33}$$

With respect to the proposed assumptions it is clear that at any stage of cosmic expansion, cosmic radius is inversely proportional to the squared cosmic temperature. The above relation (31) can be expressed as follows.

$$Z\cong\sqrt{\frac{R_0}{R_t}-1}\cong\sqrt{\frac{T_t^2}{T_0^2}-1} \tag{34}$$

where $T_t$ is the past cosmic temperature and $T_0$ is the current cosmic temperature and $T_t > T_0$. For past higher cosmic temperatures, where $T_t >> T_0$

$$Z\cong\sqrt{\frac{T_t^2}{T_0^2}-1}\cong\frac{T_t}{T_0} \tag{35}$$

This can be compared with the famous relation that is currently well believed by modern cosmologists.

$$Z+1\cong\frac{T_t}{T_0} \tag{36}$$

Thus**,** it appears likely that at least a portion of the progressively higher redshift we observe with increasing look-back distance is a manifestation of gravitational time dilation. In addition, because of this inverse square relationship over very long distances, plots of proximal galactic redshifts per unit of distance observed would be expected to look relatively linear (as seen by the weaker telescopes of the 1920's and 1930's) and deep space galactic redshifts per unit of distance observed would be expected to clearly fall away from linearity, along with decreasing luminosity, as redshifts extend into the infrared range (as reported in 1998 Type Ia supernovae observations) (Perlmutter, S. et al. 1997). Such an effect may possibly create an illusion of dark energy whose current evidence is only marginal. The following graph (**Figure 1**), according to the above relation (30), shows expected observed cosmic redshift as a function of decreasing past

cosmic radius $R_t$ pertaining to a particular astronomical observation. In this manner, increasingly greater redshifts would be expected to correspond with more distant galactic observations. The authors propose that something like this mathematical relationship could be useful in modeling the results of progressively deeper space observations. For data, see **Table 2**. In the last row of **Table 2** the past cosmic radius $R_t$ and redshift of 1090 corresponding to the recombination temperature of 2990 K are correlated. Relations (31) and (35) closely approximate the recombination temperature of 3000 K and CMBR redshift 1100 believed to be related to formation of the first hydrogen atoms. **Figure 1** may possibly provide an explanation for the nonlinearity of deep space Type Ia supernovae observations currently being attributed to "dark energy". Here it may be noted that, with reference to the suggestions proposed in the references of this paper, current universe seems to be expanding at constant rate and evidence for dark energy is only marginal.

**Figure 1: Increasing cosmic redshift vs decreasing past cosmic radius**

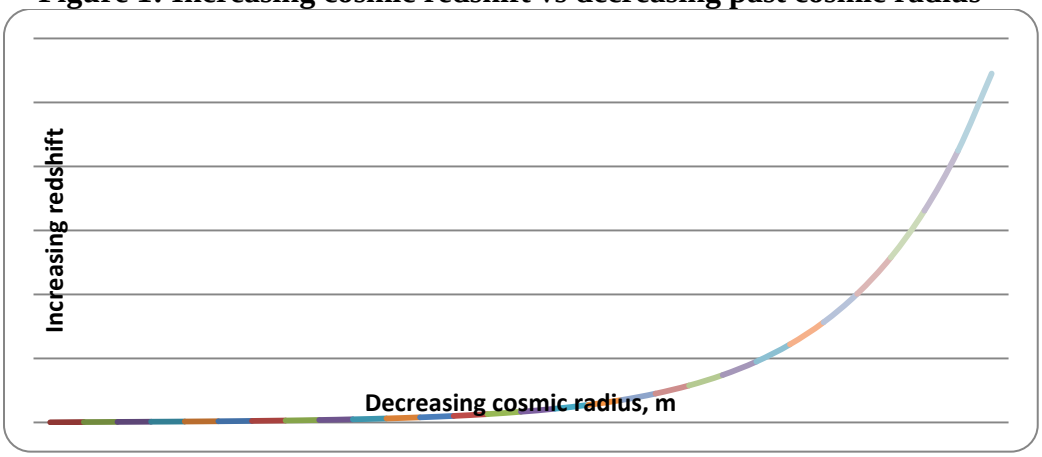


**Table 2: Cosmic physical parameters obtained with above relations**

| Assumed angular velocity (rad/sec) | Estimated cosmic radius (m) | Estimated galactic redshift | Estimated cosmic temperature (K) | Estimated cosmic age (Years) |
|---|---|---|---|---|
| 1.49229E-20 | 2.00894E+28 | 0.0 | 2.75 | 3.10619E+14 |
| 2.45930E-20 | 1.21902E+28 | 0.8 | 3.52 | 1.87839E+14 |
| 4.05292E-20 | 7.39695E+27 | 1.3 | 4.52 | 1.13589E+14 |
| 6.67921E-20 | 4.48844E+27 | 1.9 | 5.81 | 6.86886E+13 |
| 1.10073E-19 | 2.72357E+27 | 2.5 | 7.46 | 4.15361E+13 |
| 1.81401E-19 | 1.65265E+27 | 3.3 | 9.57 | 2.51167E+13 |
| 2.98949E-19 | 1.00282E+27 | 4.4 | 12.29 | 1.51878E+13 |
| 4.92668E-19 | 6.08508E+26 | 5.7 | 15.77 | 9.18374E+12 |
| 8.11917E-19 | 3.69240E+26 | 7.3 | 20.25 | 5.55316E+12 |
| 1.33804E-18 | 2.24054E+26 | 9.4 | 25.99 | 3.35781E+12 |
| 2.20509E-18 | 1.35955E+26 | 12.1 | 33.37 | 2.03032E+12 |
| 3.63398E-18 | 8.24969E+25 | 15.6 | 42.84 | 1.22764E+12 |
| 5.98881E-18 | 5.00588E+25 | 20.0 | 54.99 | 7.42282E+11 |
| 9.86955E-18 | 3.03755E+25 | 25.7 | 70.59 | 4.48810E+11 |
| 1.62650E-17 | 1.84317E+25 | 33.0 | 90.62 | 2.71363E+11 |

| | | | | |
|---|---|---|---|---|
| 2.68048E-17 | 1.11843E+25 | 42.4 | 116.34 | 1.64071E+11 |
| 4.41742E-17 | 6.78659E+24 | 54.4 | 149.35 | 9.91995E+10 |
| 7.27991E-17 | 4.11808E+24 | 69.8 | 191.73 | 5.99764E+10 |
| 1.19973E-16 | 2.49883E+24 | 89.7 | 246.13 | 3.62615E+10 |
| 1.97715E-16 | 1.51628E+24 | 115.1 | 315.97 | 2.19233E+10 |
| 3.25835E-16 | 9.20074E+23 | 147.8 | 405.62 | 1.32544E+10 |
| 5.36976E-16 | 5.58297E+23 | 189.7 | 520.71 | 8.01323E+09 |
| 8.84937E-16 | 3.38773E+23 | 243.5 | 668.46 | 4.84451E+09 |
| 1.45838E-15 | 2.05566E+23 | 312.6 | 858.13 | 2.92877E+09 |
| 2.40340E-15 | 1.24737E+23 | 401.3 | 1101.62 | 1.77058E+09 |
| 3.96081E-15 | 7.56897E+22 | 515.2 | 1414.20 | 1.07039E+09 |
| 6.52741E-15 | 4.59282E+22 | 661.4 | 1815.47 | 6.47080E+08 |
| 1.07572E-14 | 2.78691E+22 | 849.0 | 2330.61 | 3.91174E+08 |
| **1.77278E-14** | **1.69108E+22** | **1089.9** | **2991.90** | **2.36470E+08** |

## 10. Flatness and Horizon problems in modern cosmology

### 10.1 Back ground history of Flatness problem

Ever since physicist Robert Dicke first made the observation (Dicke.R.H. 1970) in 1969, cosmologists have been deeply puzzled as to how our universe appears to be expanding in a very precise way so as to perfectly balance out the attractive "force" of gravity. This is also what is meant by a "flat universe". In fact, as it was pointed out at the time, for such an apparent balance to be within observable error in the presumably opposing forces in the very early universe (within the first second after the Big Bang) must have been of equal magnitude to within one part in $10^{14}$. This has since been referred to as the "cosmological flatness problem." There is an excellent discussion of this problem in Alan Guth's book "The Inflationary Universe." As one of the pioneers and early proponents of the theory of cosmic inflation, Dr. Guth makes it very clear in his book that the flatness problem was a primary reason for which the theory of cosmic inflation was developed.

### 10.2 Past and current views of 'flatness'

According to modern cosmology, criteria for 'flatness' is: sum of observable matter density, density of dark matter and density of dark energy should be equal to the critical density, $(\rho_{cri})_0 \cong \left(3H_0^2/8\pi G\right)$. Current cosmological observations clearly suggest that, evidence to cosmic acceleration is only marginal and at present universe is expanding at a constant rate and reference there in. If so currently believed 'dark energy that assumed to be constituting ~68% of critical density' may be losing its identity in all respects. Compared to 'dark energy', 'dark matter' seems to have some underlying particle physics back ground. But so far, no one could notice or find a 'characteristic particle' that can be called as the particle related with 'dark matter'. It may be noted that, the intended purpose of 'critical density' is to show that, universe is not collapsing but accelerating. Now with reference to new study it is suggested that, universe is not collapsing but coasting at constant speed. With future Super novae observations it may also be possible to say that, universe is decelerating.

### 10.3 Modern view of horizon problem:

It had been a puzzle to cosmologists as to how a universe much larger than our own Hubble radius could have had any kind of causal connection to generate homogeneity. This has been called the "horizon problem." The theory of cosmic inflation, assumes an extremely brief period of superluminal hyper-rapid exponential expansion that believed to solve the flatness problem and the horizon problem simultaneously.

## 11. The authors opinion on flatness, homogeneity and horizon problems, the Lambda term, expansion speed and primordial density fluctuations

a) In this proposed model - from the assumptions it is clear that, from the beginning of cosmic evolution, Universe starts expanding with light speed and decelerates. As time is passing, expansion speed follows $v_t \cong \left\{1+\ln\left(\frac{\omega_{pl}}{\omega_t}\right)\right\}^{-1} c \cong \left\{1+\ln\left(\frac{R_t}{R_{pl}}\right)\right\}^{-1} c$. Important points to be noted are: 1) Expansion speed seems to be very slowly decreasing by a factor $\left\{1+\ln\left(\frac{R_t}{R_{pl}}\right)\right\}$. 2) Expansion speed seems to be inversely proportional to cosmic size or cosmic age. From table-1, in the beginning when the cosmic temperature was 2.74502E+31 K, corresponding estimated expansion speed as 8.51656E+07 m/sec. Similarly, when the cosmic temperature was 8.68052E+30 K, corresponding estimated expansion speed is 5.14869E+07 m/sec. Even though temperature is dropping by factor of 3.16, expansion speed ratio seems to be 1.65. In the recent past, when the cosmic temperature was 8.68 K, corresponding estimated expansion speed was 2.08221E+06 m/sec. When the cosmic temperature is 2.745 K, corresponding estimated expansion speed is 2.04944E+06 m/sec. Even though temperature is dropping by a factor of 3.16, expansion speed ratio seems to be 1.016 only. Then such a small difference in expansion speed cannot be observed with current technology and more over it seems to simulate the effects of 'constant rate of expansion' and 'isotropic nature' of CMBR. Thus this proposal apparently seems to be supported by the (very) recent cosmological observations that suggest 'constant rate of expansion' against "cosmic acceleration".

b) At any stage of cosmic evolution, if it is assumed that, $R_t \cong \frac{GM_t}{c^2} \cong \frac{c}{\omega_t}$, there is no need to think about cosmic collapse. Clearly speaking, at any stage of cosmic expansion, black hole universe having a size $\left(GM_t/c^2\right)$ will not collapse and will not fall down to its size. The only fundamental question to be answered is: Why universe is evolving like a balck hole with visible matter and dark matter ? It is for further stidy. It may be noted that, in section-6, the authors proposed characteristic relations for estimating the cosmological proportions of visible and dark matter contents.

c) In this proposed model, just crossing the Planck scale, at every stage of cosmic expansion, universe is confined to a size limited by $\left[R_t \cong c/\omega_t \cong GM_t/c^2\right] > \left[c/H_0\right]$. Clearly speaking, in this model current cosmic radius is 146 times more than the current Hubble radius. Thus the solu-

tion to the "horizon problem" is built into this model, not because the authors designed it with that intention, but because a universe bounded by $R_0 \cong c/\omega_0 \cong GM_0/c^2$ will always be causally connected.

d) In addition, if the current universe is very large and current cosmic age is also large, then it is certainly possible to understand the intended purpose of cosmic inflation. In this context, the authors' proposed fifth assumption can be given considerable importance. In this proposed model, in the first second of cosmic expansion, the universe expands from $1.6162\times10^{-35}$ m to $3.15\times10^{6}$ m and the ratio of expansion is $1.95\times10^{41}$. Similarly, in one second from the Planck scale, temperature drops from $9.67792\times10^{31}$ K to $2.19\times10^{11}$ K and the ratio of temperature drop in the first second is $4.423\times10^{20}$. Thus by considering these ratios the intended purpose of 'cosmic inflation effect' can be understood at fundamental level without requiring new physics.In addition, the estimated current age is 21400 times higher than the currently believed cosmic age. Thus past and current assumed effects of cosmic inflation can be understood. Clearly speaking, as cosmic time is very large, there is lot scope for generation of ordered structures and smoothness in CMBR temperature.

e) If one is willing to consider the famous "Lambda" term connected with cosmic evolution, then qualtatively it can be expressed as follows.

$$\left.\begin{aligned} \Lambda_t\left(\frac{c^4}{G}\right) &\cong \left(\frac{9c^2\omega_t^2}{20\pi G}\right) \cong aT_t^4 \quad \text{and} \\ \Lambda_t &\cong \left(\frac{9c^2\omega_t^2}{20\pi G}\right)\left(\frac{c^4}{G}\right)^{-1} \cong \left(\frac{9\omega_t^2}{20\pi c^2}\right) \\ &\cong aT_t^4\left(\frac{c^4}{G}\right)^{-1} \cong \frac{GaT_t^4}{c^4} \end{aligned}\right\} \tag{37}$$

Here $\left(c^4/G\right)$ can be considered as the characteristic vacuum force that drives the universe forever. It can also be considered as the characteristic constant centripetal force of the light speed rotating universe. $\Lambda_t\left(\frac{c^4}{G}\right)$ can be considered as the characteristic vacuum energy density. Clearly speaking, magnitude of $\Lambda_t$ is directly proportional to cosmic thermal energy density or directly proportional to cosmic gravitational self energy density.

Current magnitude of $\Lambda$ can be expressed as:

$$\left.\begin{aligned} \Lambda_0 &\cong \left(\frac{9c^2\omega_0^2}{20\pi G}\right)\left(\frac{c^4}{G}\right)^{-1} \cong \left(\frac{9\omega_0^2}{20\pi c^2}\right) \\ &\cong \frac{GaT_0^4}{c^4} \cong 3.5415\times10^{-58}\ \text{m}^{-2} \end{aligned}\right\} \tag{38}$$

At the Planck scale, $\Lambda$ can be expressed as:

$$\Lambda_{pl} \cong \frac{GaT_{pl}^4}{c^4} \cong 5.4836626\times10^{68}\ \text{m}^{-2} \tag{39}$$

$$\begin{aligned}\frac{\Lambda_{pl}}{\Lambda_0} &\cong \left(\frac{aT_{pl}^4}{aT_0^4}\right) \cong \left(\frac{9\omega_{pl}^2}{20\pi c^2}\right) \Big/ \left(\frac{9\omega_0^2}{20\pi c^2}\right) \\ &\cong \left(\frac{T_{pl}^4}{T_0^4}\right) \cong \left(\frac{\omega_{pl}^2}{\omega_0^2}\right) \cong 1.5484\times10^{126}\end{aligned} \tag{40}$$

If so, at any stage of cosmic expansion, cosmic speed of expansion $v_t$ can be estimated as follows.

$$\left.\begin{aligned}&\frac{\Lambda_{pl}}{\Lambda_t} \cong \left(\frac{\omega_{pl}^2}{\omega_t^2}\right) \cong \left(\frac{H_{pl}^2}{H_t^2}\right)\left(\frac{c^2}{v_t^2}\right) \\ &\rightarrow v_t \cong \left[\left(\frac{H_{pl}}{H_t}\right)\sqrt{\frac{\Lambda_t}{\Lambda_{pl}}}\right]c \\ &\Rightarrow v_t \propto \left(\frac{\sqrt{\Lambda_t}}{H_t}\right)\end{aligned}\right\} \tag{41}$$

For the current case,

$$\left.\begin{aligned}&\frac{\Lambda_{pl}}{\Lambda_0} \cong \left(\frac{\omega_{pl}^2}{\omega_0^2}\right) \cong \left(\frac{H_{pl}^2}{H_0^2}\right)\left(\frac{c^2}{v_0^2}\right) \\ &\rightarrow v_0 \cong \left[\left(\frac{H_{pl}}{H_0}\right)\sqrt{\frac{\Lambda_0}{\Lambda_{pl}}}\right]c \\ &\cong 2.05\times10^6\ \text{m.sec}^{-1}.\end{aligned}\right\} \tag{42}$$

f) Cosmologists also postulate that primordial density perturbations resulting from primordial quantum fluctuations are responsible for the structure of the universe we see today. This also seems reasonable in this proposed model. This proposed model is inherently connected with Planck scale. Planck scale itself may be responsible for the assumed primordial density fluctuations. Any how, in this context more study and additional mathematical modeling seems to be required.

## 12. **Conclusion**

The authors stress the fact that, subject of cosmology is subjected to time to time cosmological observations, critical reviews on old concepts and new models of cosmology (U. V. S. Seshavatharam and Lakshminarayana S 2015, Tatum, E. T et al 2015, Seshavatharam et al 2015, Tatum, E.T 2015 a, 2015 b). With reference to current available data, qualitatively and

quantitatively this proposed unified model can be analyzed theoretically in many possible ways. It may be true that, ratio of angular velocity and Hubble parameter is model dependent. Theoretically, compared to cosmic size and cosmic mass estimations, estimation of cosmic angular velocity seems to be easy and may yield workable models of cosmology. Now it seems essential to think and focus on developing 'observational methods' of cosmic angular velocity.

By considering the Planck scale, in this paper, the authors assumed that, $H_t \cong \omega_t \left\{1+\ln\left(\omega_{pl}/\omega_t\right)\right\}$ and is for further critical study. As the assumed angular velocity is interlinked with Planck scale, its significance cannot be ignored. In future, either from 'academic interest' point of view or from 'serious research' point of view:

**1)** By considering 'initial light speed expansion' and 'continuous light speed rotation' subject of cosmology can be simplified.
**2)** By guessing the 'Black hole radius' concept, subject of cosmology can be strengthened.
**3)** By guessing different ratios of angular velocity and Hubble parameter - different models of cosmology can be developed and a unified model of flat space (spherical) cosmology can be developed with respect to observational confirmation of the magnitudes of visible and dark matter densities.
**4)** With quantum gravity point of view or quantum cosmology point of view, relations (9) and (10) can be recommended for in depth study and analysis.
**5)** With reference to Hindu cosmology, modern cosmology can be reviewed at fundamental level.

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