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Toy Model of Spinning Quantum Cosmology

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Authors' contributions

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

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ABSTRACT

In this paper, we show one theoretical possibility for cosmic rotation. We would like to appeal that: 1) Spin is a basic property of quantum mechanics and a globally rotating universe is consistent with general relativity and quantum gravity. 2) As physical understanding and physical evidence of dark energy is very poor, it is better to search for alternative concepts. 3) With reference to the well established 70% dark energy, it is possible to have a 'concrete' theory of cosmic rotation. In this toy model: at $H_0 \cong 70\text{km/sec/Mpc}$ and $T_0 \cong 2.722$ K, 1) Estimated current ordinary matter density is 0.04341 $\left(\frac{3H_0^2}{8\pi G}\right)$ and corresponding cosmic radius and maximum expansion velocity are: 29 Gpc and $6.8c$ respectively. 2) Current cosmic rotational kinetic energy density is 0.667 $\left(\frac{3H_0^2 c^2}{8\pi G}\right)$. We

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would like to emphasize that dark energy can be identified with cosmic rotational kinetic energy. Our toy model is coherent in connecting most of the cosmic physical parameters and one very interesting point to be noted is that, it is one 'inflation free' model. With further study, a unified model of quantum cosmology can be developed with and without inflation.

Keywords: Cosmic rotation; general relativity; quantum gravity; dark energy; cosmic rotational kinetic energy density; expansion velocity; quantum cosmology; inflation.

NOMENCLATURES

1) $(\Omega_{OM}) =$ *Ratio of ordinary matter density to critical density.*
2) $(\Omega_{DM}) =$ *Ratio of dark matter density to critical density.*
3) $(\Omega_{DE}) =$ *Ratio of dark energy density to critical energy density.*
4) $H =$ *Hubble parameter.*
5) $\omega =$ *Cosmic angular velocity.*
6) $R =$ *Cosmic radius.*
7) $M =$ *Cosmic (ordinary) mass.*
8) $I =$ *Cosmic moment of inertia =* $f_i MR^2$ *where* f_i *= Inertial factor associated with cosmic ordinary matter density.*
9) $K_{rot} =$ *Cosmic rotational kinetic energy.*
10) $\dfrac{(K_{rot})}{\frac{4\pi}{3}R^3} =$ *Cosmic rotational kinetic energy density = Dark energy density =* $(\Omega_{DE})\left(\dfrac{3H^2c^2}{8\pi G}\right)$.
11) $(\lambda_{max}) =$ *Cosmic thermal wavelength.*
12) $T =$ *Cosmic temperature* $= \dfrac{2.898\times10^{-3}\,K.m}{(\lambda_{max})}$.
13) $V =$ *Cosmic expansion velocity = Cosmic rotational velocity. (Based on* $\omega = H$ *and Hubble's law)*
14) $(d_g) =$ *Galactic distance from and about the point of big bang.*
15) $(v_g) =$ *Galactic receding speed from and about the point of big bang.*

Note-1: For the above symbols, subscript t denotes time dependent value, 0 denotes current value and pl denotes Planck scale value.

Note-2: $\beta \cong$ A new number related with quantum constants $\cong 4.96511423\left(\dfrac{45}{128\pi^7}\right)^{\frac{1}{4}} \cong 0.51572.$

1. INTRODUCTION

By implementing 'Planck scale' and 'Mach's principle', in a quantitative approach [1,2], we make an attempt to develop a toy model of 'spinning quantum cosmology'. We would like to appeal that, this kind of approach may help in resolving the basic issues of modern cosmology at a fundamental level. This paper is a refined version of our recent publication on 'quantum cosmology with evolving dark energy' and readers are strongly encouraged to go through [3]. Motivating points that need a special focus are: 1) As there is no physical understanding of dark energy, there is a need for developing alternative models of cosmology. 2) So far no one could find applications of dark energy in other areas of physics. 3) As there is no physical evidence for extra dimensions, cosmological models can be confined to 3+1 dimensions. 4) As current science and technology is lagging in distinguishing 'free space' and 'cosmic space', it is better to have 'common space' paradigm. 5) Quantum gravity point of view, standard cosmology is in its budding stage and needs a serious review. 6) It may be noted that, 'spin' is one of the vital characteristics of quantum mechanics. 7) With reference to Planck scale and currently observed cosmic boundary of ≈ 93 Gly, non-inflationary cosmological models can be developed. 8) By considering a 3+1 dimensional spherical universe with expansion and rotation, it is also possible to have a model of cosmology. 9). Rotational models consistent with quantum gravity can be developed. 10). In the current gigantic universe, if current angular velocity is very small and if observer's location/position is unknown, it is impossible to disprove cosmic rotation. 11). To develop a unified model of cosmology, to the possible extent one can try for accommodating Friedmann relations in quantum cosmology models.12). Alternative cosmological models should be reviewed in an unbiased approach. In this paper, we try to estimate current cosmic radius, current ordinary mass and its current rotational kinetic energy in a quantum gravity approach. By considering "Planck scale" as a characteristic limit of the evolving universe, we wish to show that the Planck scale Hubble parameter plays a crucial role in the entire cosmic evolution. This is an entirely new picture and we appeal the readers to consider it as a toy model of quantum cosmology without inflation. We hope that, with further study, scientific drawbacks of this model can be resolved by considering 'inflation' concepts.

1.1 About 'Quantum Gravity' and 'General Theory of Relativity'

It may be noted that, with reference to quantum gravity, the General theory of relativity is an approximate model for understanding cosmology on large scale distances irrespective of quantum phenomena. Cosmic expansion, Lambda term, dark matter, cosmic temperature, inflation, dark energy and vacuum energy are different concepts, using by which alternative models of GTR are emerging and are being extended in many ways. Quantum gravity is a wide range model for understanding cosmology on large scale distances with embedded quantum phenomena. To have a unified theory of cosmology, it seems essential to modify GTR with reference to cosmological quantum phenomena. So far, progress in this direction is very nominal and needs a serious review. To understand the situation, we quote three important statements made by M. Bojowald [1], T. Padmanabhan [4] and C. Sivaram [5].

According to M. Bojowald:

1) "Quantum cosmology is based on the idea that quantum physics should apply to anything in nature, including the whole universe. Quantum descriptions of all kinds of matter fields and their interactions are well known and can easily be combined into one theory - leaving aside the more complicated question of unification, which asks for a unique combination of all fields based on some fundamental principles or symmetries. Nevertheless, quantizing the whole universe is far from being straightforward because, according to general relativity, not just matter but also space and time are physical objects. They are subject to dynamical laws and have excitations (gravitational waves) that interact with each other and with matter. Quantum cosmology is therefore closely related to quantum gravity, the quantum theory of the gravitational force and space-time. Since quantum gravity remains unfinished, the theoretical basis of quantum cosmology is unclear. And to make things worse, there are several difficult conceptual problems to be overcome".
2) "We remain far from a proper understanding of quantum cosmology, especially when physics at the Planck scale is involved. At the same time, research on quantum cosmology has led to progress in our understanding of generally covariant quantum systems and often showed unexpected effects of quantum space-time".

According to T. Padmanabhan: "One natural - and in fact, inevitable - contribution to cosmological constant arises from the energy density of quantum vacuum fluctuations. The trouble is, we do not know how to compute the gravitational effects of quantum fluctuations of the vacuum from first principles. Naive estimates suggest that this will give $\Lambda\left(\frac{G\hbar}{c^3}\right)\approx 1$ which misses the correct result by 120 orders of magnitude! It is possible to get around this difficulty and get the correct value but only if we are prepared to make some extra assumptions. The appearance of G and $\hbar$ together strongly suggests that the problem of dark energy needs to be addressed by quantum gravity. None of the currently popular models of quantum gravity has anything meaningful to say on this issue (let alone predict its correct value). In fact, explaining the observed value of the dark energy is the acid test for any quantum gravity model and all the models currently available flunk this test. There is no doubt that, when we eventually figure this out, it will lead to as drastic a revolution in our conceptual understanding as relativity and quantum theory did".

According to C. Sivaram: "Although there has been a considerable spurt of recent interest in research in several formal aspects of quantum gravity including considerable mathematical progress, the subject still remains enigmatic and remote from other areas of physics. Despite several suggestions and complex models, no clear cut consistent consensus on uniting quantum theory and gravity has emerged. It would appear as if quantum gravity has no implications or impact on the rest of everyday mundane physics which depends on measurement or observation of well defined physical quantities or properties that characterize a system or a substance. We shall see that this is not strictly true. It is possible to carry out calculations of the effects of quantum gravity on certain systems and come out with numbers! This has been known for some time especially in the case of a weak field in a linearized theory".

1.2 To Choose the Magnitude of H_0

1) As per the 2015 Planck data [6]: $H_0 \cong (67.31 \pm 0.96)$ km/sec/Mpc and the present temperature of the CMB radiation is, $T_0 \cong (2.722 \pm 0.027)$ K.
2) According to the advanced observational data analysis by A.G. Riess et al. [7], current best value of $H_0 \cong (73.24 \pm 1.74)$ km/sec/Mpc.
3) With reference to $T_0 \cong 2.722$ K and our proposed set of assumptions, in this paper, we choose, $H_0 \cong 70\text{km/sec/Mpc} \cong 2.26853\times 10^{-18}\,sec^{-1}$. This value seems to lie in between (67.31 and 73.24) km/sec/Mpc.

1.3 To Understand the Role of the Planck Scale in Entire Cosmic Evolution

So far no cosmological model implemented Planck scale in current cosmic evolution. In this complicated situation, in a positive approach, we make an attempt to implement the 'Planck scale' in the entire cosmic evolution. With further study, our approach can be developed for a better understanding. Based on quantum gravity [1,2], we define the Planck scale Hubble parameter, $H_{pl} \cong \sqrt{\frac{c^5}{G\hbar}} \cong 1.855\times 10^{43}$ sec $^{-1}$. To proceed further, we define that,

$$\sqrt{\left(\frac{3H_t^2c^2}{8\pi G\left(aT_t^4\right)}\right)} \cong \gamma_t \cong \left[1+\ln\left(\frac{H_{pl}}{H_t}\right)\right] \quad (1)$$

where H_t is the time dependent Hubble parameter.

1.4 To Understand the Role of Ordinary Matter Density in the Entire Cosmic Evolution

In a data fitting approach, we define a cosmic thermal wavelength, at any stage of cosmic evolution,

$$\left(\lambda_{max}\right)_t \cong \left(\frac{1}{\left(\Omega_{OM}\right)_t}\right)\frac{c}{\sqrt{H_{pl}H_t}} \quad (2)$$

Here $\frac{c}{\sqrt{H_{pl}H_t}} \cong \sqrt{\left(\frac{c}{H_{pl}}\right)\left(\frac{c}{H_t}\right)}$ can be called 'mean' Planck-Hubble radius.

The temperature of the CMB radiation at any arbitrary point of time is,

$$T_t \cong \frac{2.898\times10^{-3}\,\text{Km}}{(\lambda_{max})_t} \cong (\Omega_{OM})_t \times \frac{h\sqrt{H_{pl}H_t}}{4.965114k_B} \tag{3}$$

1.5 To Estimate the Ordinary Matter Density

Based on the above relations, it is possible to show that, the density parameter of ordinary matter is,

$$(\Omega_{OM})_t \cong \left(\frac{M_t}{\frac{4\pi}{3}R_t^3}\right) \div \left(\frac{3H_t^2}{8\pi G}\right) \cong \frac{0.51572}{\sqrt{\gamma_t}} \cong \frac{\beta}{\sqrt{\gamma_t}}. \tag{4}$$

As γ_t increases, the magnitude of $(\Omega_{OM})_t$ decreases. With further study, in a quantum-gravity approach, the mystery of ordinary matter density can presumably be understood. Based on relation (4),

$$(\lambda_{max})_t \cong \left(\frac{\sqrt{\gamma_t}}{\beta}\right)\frac{c}{\sqrt{H_{pl}H_t}} \tag{5}$$

$$T_t \cong \left(\frac{\beta}{\sqrt{\gamma_t}}\right) \times \frac{h\sqrt{H_{pl}H_t}}{4.965114k_B} \tag{6}$$

1.6 To Understand the Role of Mach's Principle in Entire Cosmic Evolution

In a quantitative approach, Mach's principle [2] can be understood with the relation,

$$GM \cong c^2R \tag{7}$$

With reference to cosmic evolution and ordinary matter, we make an attempt to modify this relation as,

$$GM_t \cong c^2R_t \tag{8}$$

Based on relations (4) and (8) and by writing M_t as

$$M_t \cong \left[(\Omega_{OM})_t\left(\frac{3H_t^2}{8\pi G}\right)\left(\frac{4\pi}{3}R_t^3\right)\right] \tag{9}$$

It is possible to show that,

$$R_t \cong \frac{GM_t}{c^2} \cong \sqrt{\frac{2}{(\Omega_{OM})_t}}\frac{c}{H_t} \cong \sqrt{\frac{2\sqrt{\gamma_t}}{\beta}}\frac{c}{H_t} \tag{10}$$

2. ASSUMPTIONS PERTAINING TO QUANTUM COSMOLOGY

Based on Mach's principle and quantum gravity, we imagine our universe as a quantum gravity sphere and assume that, at any stage of cosmic evolution:

1) The Planck scale Hubble parameter plays a crucial role.
2) Space-time curvature follows, $GM_t \cong R_tc^2$ where M_t and R_t represent the ordinary cosmic mass and radius respectively.
3) Cosmic thermal wavelength is inversely proportional to the ordinary matter density.
4) The magnitude of angular velocity is equal to the magnitude of the Hubble parameter.

2.1 The Semi Empirical Relations Connected with Quantum Gravity

With reference to the set of assumptions, at any stage of cosmic evolution, we choose the following set of 'semi empirical model relations'. One can modify them for a better understanding.

1) Based on relations (1) to (10) and with reference to $(\Omega_{OM})_t$, $R_t \cong \sqrt{\frac{2}{(\Omega_{OM})_t}}\frac{c}{H_t}$.

2) In a rotating and expanding universe, $V_t \cong R_t\omega_t \cong R_tH_t \cong \sqrt{\frac{2}{(\Omega_{OM})_t}}c$

3) Based on relations (1) to (10) and with reference to $\left(\Omega_{OM}\right)_t$,

$$M_t \cong \sqrt{\frac{2}{\left(\Omega_{OM}\right)_t}}\frac{c^3}{GH_t} \cong \frac{c^2 V_t}{GH_t}$$

4) From above relations and with reference to rotational dynamics,

$$\left(K_{rot}\right)_t \cong \frac{1}{2} I_t \omega_t^2 \cong \frac{1}{2} I_t H_t^2 \cong \frac{f_i}{2} M_t R_t^2 H_t^2$$

where $f_i \cong$ Inertial factor assocaited with cosmic moment of inertia

5) Based on Friedmann's density sum rule,

$$\left(\Omega_{DM}\right)_t = 1 - \left[\left(\Omega_{OM}\right)_t + \frac{\left(K_{rot}\right)_t}{\frac{4\pi}{3} R_t^3}\right]$$

2.2 To Choose Various Values of γ and H

If defined $H_{pl} \cong 1.854921 \times 10^{43}\ sec^{-1}$, one can choose different values of γ in between $\gamma_{pl} \cong 1$ and $\gamma_0 \cong 141.2564$. For each value of γ, one can get a corresponding H and all other physical parameters can be estimated.

3. CURRENT COSMIC PHYSICAL PARAMETERS

In a heuristic approach, if one is willing to consider the relations proposed in section-2.2, magnitude of the current and the Planck scale cosmological physical parameters can be fitted/predicted. It needs further study.

If $T_0 \cong 2.722$ K, $\left(\lambda_{max}\right)_0 \cong 1.06466$ mm and $H_0 \cong 2.26853 \times 10^{-18}\, sec^{-1} \cong 70\text{km/sec/Mpc}$,

1) $$\sqrt{\left(\frac{3H_0^2 c^2}{8\pi G\left(aT_0^4\right)}\right)} \cong \gamma_0 \cong 141.2564$$

2) $$\left(\Omega_{OM}\right)_0 \cong \frac{0.51572}{\sqrt{\gamma_0}} \cong 0.04341$$

3) $$R_0 \cong \sqrt{\frac{2}{\left(\Omega_{OM}\right)_0}}\frac{c}{H_0} \cong 8.97 \times 10^{26}\,\text{m}$$
$$\cong 94.8154\ \text{Gly} \cong 29.085\ \text{Gpc}$$

4) $$V_0 \cong R_0 \omega_0 \cong R_0 H_0 \cong \sqrt{\frac{2}{\left(\Omega_{OM}\right)_0}}\,c \cong 6.79c$$

5) $$M_0 \cong \sqrt{\frac{2}{\left(\Omega_{OM}\right)_0}}\frac{c^3}{GH_0} \cong \frac{c^2 V_t}{GH_0}.$$
$$\cong 1.208 \times 10^{54}\ \text{kg}$$

6) If current cosmic sphere is a thin spherical shell with very low ordinary matter density,

$$\left(K_{rot}\right)_0 \cong \frac{1}{3} M_0 R_0^2 H_0^2 \cong 1.667 \times 10^{72} J$$

where $f_i \cong \frac{2}{3}$

7) Current cosmic rotational kinetic energy density $\cong \frac{\left(K_{rot}\right)_0}{\frac{4\pi}{3} R_0^3} \cong 0.667\left(\frac{3H_0^2 c^2}{8\pi G}\right)$

8) $$\left(\Omega_{DM}\right)_0 = 1 - \left[\left(\Omega_{OM}\right)_0 + \frac{\left(K_{rot}\right)_0}{\frac{4\pi}{3} R_0^3}\right] \cong 0.2899$$

4. PLANCK SCALE PHYSICAL PARAMETERS

1) $$\sqrt{\left(\frac{3H_{pl}^2 c^2}{8\pi G\left(aT_{pl}^4\right)}\right)} \cong \gamma_{pl} \cong 1$$

2) $$\left(\Omega_{OM}\right)_{pl} \cong \frac{0.51572}{\sqrt{\gamma_{pl}}} \cong 0.5157 \cong \beta$$

3) $$T_{pl} \cong \left(\frac{3H_{pl}^2 c^2}{8\pi Ga}\right)^{\frac{1}{4}} \cong 9.247 \times 10^{31}\ \text{K}$$

4) $(\lambda_{max})_{pl} \cong \dfrac{2.898\times10^{-3}\,\mathrm{K.m}}{T_{pl}} \cong 3.134\times10^{-35}\,m$

5) $R_{pl} \cong \sqrt{\dfrac{2}{(\Omega_{OM})_{pl}}}\dfrac{c}{H_{pl}} \cong 3.183\times10^{-35}\,\mathrm{m}$

6) $V_{pl} \cong R_{pl}\omega_{pl} \cong R_{pl}H_{pl} \cong \sqrt{\dfrac{2}{(\Omega_{OM})_{pl}}}c \cong 1.97c$

7) $M_{pl} \cong \sqrt{\dfrac{2}{(\Omega_{OM})_{pl}}}\dfrac{c^3}{GH_{pl}} \cong \dfrac{c^2V_{pl}}{GH_{pl}}$

$\cong 4.29\times10^{-8}$ kg

8) If Planck scale universe is a point sphere of high density,

$$(K_{rot})_{pl} \cong \frac{1}{5}M_{pl}R_{pl}^2H_{pl}^2 \cong 2.99\times10^9\,J$$

$$\text{where } f_i \cong \frac{2}{5}$$

9) Planck scale cosmic rotational kinetic energy density

$$\cong \frac{(K_{rot})_{pl}}{\frac{4\pi}{3}R_{pl}^3} \cong 0.40\left(\frac{3H_{pl}^2c^2}{8\pi G}\right).$$

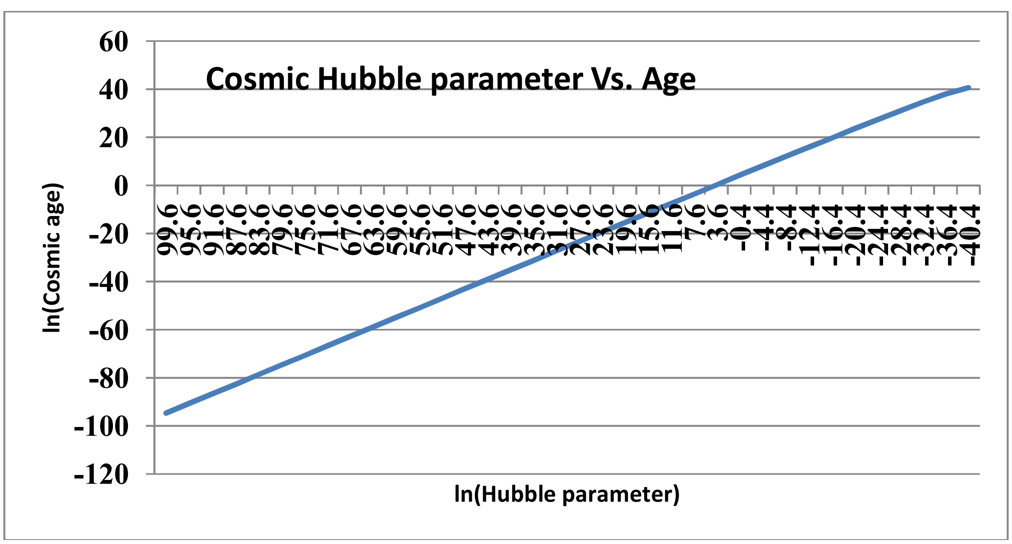
10) $(\Omega_{DM})_{pl} \cong 1-\left[(\Omega_{OM})_{pl} + \dfrac{(K_{rot})_{pl}}{\frac{4\pi}{3}R_{pl}^3}\right] \cong 0.0843$

5. TO UNDERSTAND THE COSMIC AGE

With reference to the Planck scale cosmic age of $\approx \dfrac{1}{H_{pl}} \cong \sqrt{\dfrac{G\hbar}{c^5}}$, current cosmic age of $\approx \dfrac{1}{H_0}$ and standard cosmology based cosmic age of 380,000 years pertaining to 3000 K, with trial-error we developed the following semi empirical relation. We are working on understanding its physical back ground and needs further study.

$$(t\times H_t)\approx\left[1+\ln\left(\frac{H_t}{H_0}\right)\right]\cong(\gamma_0-\gamma_t)+1 \qquad (11)$$

Based on this relation, cosmic age corresponding to a temperature of ≈ 3000 K, Hubble parameter of $\approx 2.5\times10^{-12}\,sec^{-1}$ and $\gamma_t \approx 127.344$ could be around 189,022 years. This is roughly about half of the current estimations of 380,000 years. See the following Picture 1 for cosmic age. In this picture, X-axis represents the natural logarithm of Hubble parameter and Y-axis represents the natural logarithm of cosmic age.



Picture 1. To understand the cosmic age with Hubble parameter

6. TO INTERPRET THE OBSERVED COSMIC REDSHIFT AND VELOCITY-DISTANCE RELATION

In terms of the proposed terms $(\gamma_0 \text{ and } \gamma_t)$, redshift associated cosmic scale factor and past Hubble parameter can be expressed in the following way.

1) Inverse of the cosmic scale factor can be expressed with,

$$(z+1) \cong \frac{T_t}{T_0} \cong \frac{(\lambda_{max})_0}{(\lambda_{max})_t} \cong \left(\frac{(\Omega_{OM})_t}{(\Omega_{OM})_0}\right)\sqrt{\frac{H_t}{H_0}} \cong \sqrt{\frac{\gamma_0}{\gamma_t}} \exp\left(\frac{\gamma_0 - \gamma_t}{2}\right)$$
$$\rightarrow z \cong \left(\frac{T_t}{T_0}\right) - 1 \cong \left(\frac{(\lambda_{max})_0}{(\lambda_{max})_t}\right) - 1 \cong \left\{\left(\frac{(\Omega_{OM})_t}{(\Omega_{OM})_0}\right)\sqrt{\frac{H_t}{H_0}}\right\} - 1 \cong \left\{\sqrt{\frac{\gamma_0}{\gamma_t}} \exp\left(\frac{\gamma_0 - \gamma_t}{2}\right)\right\} - 1 \quad (12)$$

2) Time dependent Hubble parameter can be expressed with,

$$H_t \cong \left(\frac{(\Omega_{OM})_0}{(\Omega_{OM})_t}\right)^2 (z+1)^2 H_0 \cong \left(\frac{\gamma_t}{\gamma_0}\right)(z+1)^2 H_0 \cong e^{(\gamma_0 - \gamma_t)} H_0 \quad (13)$$

3) At present, from and about the point of big bang, galactic receding speeds can be approximated with,

$$(v_g)_0 \cong \left(\frac{(d_g)_0}{R_0}\right) V_0 \cong \left(\frac{V_0}{R_0}\right)(d_g)_0 \cong H_0 (d_g)_0 \quad (14)$$

It can be compared with currently believed Hubble's law for the current expanding universe.

7. POSSIBLE IMPLICATIONS OF OUR PROPOSED SET OF ASSUMPTIONS

7.1 Cosmological Constant Problem

With reference to assumption-1, the ratio of the Planck scale critical density to the current critical density is,

$$\left(\frac{3H_{pl}^2 c^2}{8\pi G}\right) \div \left(\frac{3H_0^2 c^2}{8\pi G}\right) \cong \left(\frac{H_{pl}}{H_0}\right)^2 \cong 6.685 \times 10^{121} \quad (15)$$

We wish to appeal that, our assumption-1 can be considered as a characteristic tool for constructing a model of 'quantum gravity'.

7.2 Horizon Problem

The 'horizon problem' is a problem with the standard cosmological model of the Big Bang. It points out that different regions of the universe have not 'contacted' each other because of the great distances between them, but nevertheless they have the same temperature and other physical properties. If one is willing to consider the concept of 'matter causes the space-time to curve', 'horizon problem' can be understood. According to hot big bang model, during its evolution, as the universe is expanding, thermal radiation temperature decreases and matter content increases. As matter content increases, based on Mach's principle [2], at any stage of evolution, it is possible to have an increasing radius of curvature, $R_t \cong \frac{GM_t}{c^2}$. For the current case, $R_0 \cong \frac{GM_0}{c^2} \cong 29 \text{ Gpc}$ and there is no scope for 'causal disconnection' of visible matter.

7.3 Cosmic Inflation

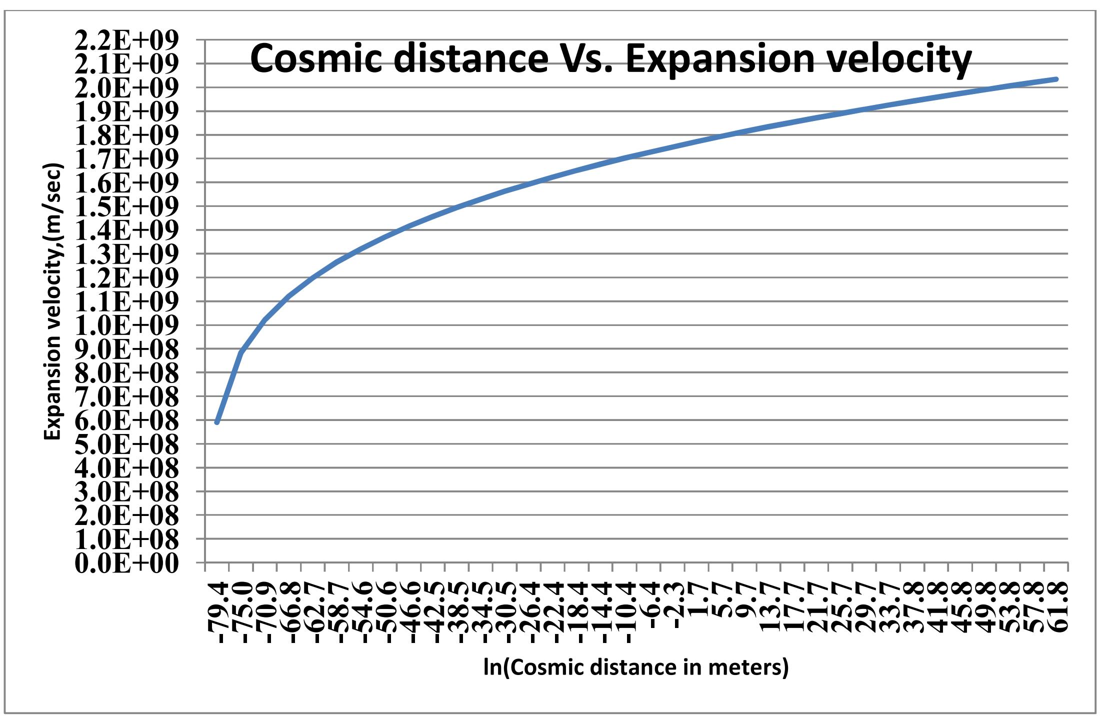
Mainstream cosmologists believe that the superluminal expansion period of the universe (called "cosmic inflation") ended by 10^{-32} seconds (a tiny fraction of a second) after the hot big bang [8]. Since that time, they believe, expansion initially decelerated (from gravity) and then, after about 6 billion years, began very slowly to accelerate (from dark energy). Many cosmologists proposed different starting mechanisms for initiating and fine tuning the believed 'inflation'. In this context, we would like to stress the fact that, with $R_0 \cong \sqrt{\frac{2}{(\Omega_{OM})_0}}\left(\frac{c}{H_0}\right)$, estimated current cosmic radius is 94.815 Gly =29.08 Gpc and is just twice of the modern estimate [9]! Thinking in this way and by considering our proposed assumptions, currently believed cosmic inflation can be reviewed [10,11] and possibly, can be relinquished. Alternatively, by incorporating 'inflation' concepts, models of quantum cosmology with inflation can also be developed. See the following Picture 2 for natural logarithm of cosmic distance and expansion velocity.

7.4 CMBR Anisotropy

Temperature fluctuations are directly proportional to actual galactic ordinary matter density fluctuations. Clearly speaking, observed hot spots and cold spots can be interpreted with higher and lower (ordinary) matter densities pertaining to galactic surroundings.

7.5 Cosmic Rotation

As there exists no well established relation in between Hubble parameter and angular velocity, many of the modern cosmologists do not believe in cosmic rotation. We would like to appeal that, rotation is a natural phenomena for most of the sub-universal objects like galaxies, stars and planets and current gigantic universe can also be imagined to be an evolving and rotating sphere. Over the last sixty plus years, numerous rotating and expanding general relativity-compatible cosmological models have been developed [12-27]. L.M. Chechin is seriously working on various issues connected with cosmic rotation [21,22].



Picture 2. Cosmic distance Vs. Cosmic expansion velocity

7.6 Cosmic Axis of Rotation

In the current gigantic universe, tracing the 'point of big bang' and tracing the 'rotational axis' are most challenging tasks. First of all, one must believe in their existence. It needs reliable observational support. It may be noted that, many of the cosmological observations are complicated to interpret. Recent observations seem to shed light on the 'cosmic axis of evil' and 'axial alignment' of distant galaxies and quasars. In this context, one can see the main stream journal articles on cosmic axis of rotation and observational effects of cosmic rotation [28-41].

7.7 Λ Term Vs Cosmic Deceleration

Centrifugal deceleration can be expressed with:

$$\frac{V_t^2}{R_t} \cong V_t H_t \cong GM_t\left(\frac{H_t^2}{c^2}\right) \quad (16)$$

By neglecting factor 3, qualitatively, if one is willing to identify $\left(\frac{H_t^2}{c^2}\right)$ with Λ_t , it is possible to show that,

$$\Lambda_t \approx \frac{V_t H_t}{GM_t} \quad (17)$$

It may be noted that, in standard cosmology, Λ_t is a controversial term assumed to be associated with cosmic expansion in the form of repulsive gravity. We would like to suggest that, Λ_t term can be physically interpreted with the ratio of cosmic deceleration, $V_t H_t$ and cosmic inertial constant, GM_t. Based on this kind of interpretation,

$$\frac{\Lambda_{pl}}{\Lambda_0} \approx \left(\frac{V_{pl} H_{pl}}{GM_{pl}}\right) \div \left(\frac{V_0 H_0}{GM_0}\right) \approx \left(\frac{H_{pl}}{H_0}\right)^2 \quad (18)$$

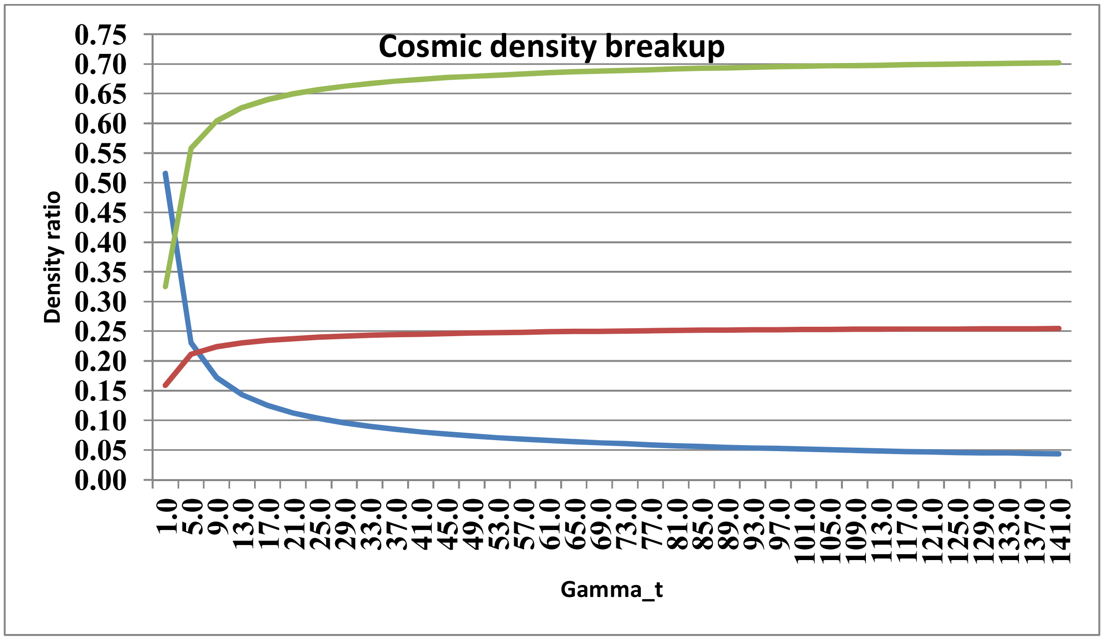
7.8 To Estimate Dark Matter

With available data and technology, at present it may not be possible to prove cosmic rotation. If indeed there exists cosmic rotation, cosmic rotational kinetic energy depends on the cosmic inertial factor. For a high dense sphere, the cosmic moment of inertia is $\frac{2}{5}M_t R_t^2$ and for a low dense sphere, the cosmic moment of inertia is $\frac{2}{3}M_t R_t^2$. The corresponding rotational kinetic energy densities seem to be $0.4\left(\frac{3H_{pl}^2 c^2}{8\pi G}\right)$ and $0.67\left(\frac{3H_0^2 c^2}{8\pi G}\right)$ respectively. Keeping these numbers in mind, with a semi empirical ad hoc relation of the kind,

$$\left(\Omega_{DM}\right)_t \approx \frac{\beta^2}{\exp\left(\Omega_{OM}\right)_t} \quad (19)$$

it is possible to estimate $\left(\Omega_{DM}\right)_t$. Based on this kind of relation and with reference to currently believed 'cosmic density sum rule', for the Planck scale, $\left(\Omega_{OM}\right)_{pl} \approx 0.5157,\quad \left(\Omega_{DM}\right)_{pl} \approx 0.159$ and $\left(\frac{\left(K_{rot}\right)}{\frac{4\pi}{3}R^3}\right)_{pl} \approx 0.325 \sim 0.40$. For the current scale, $\left(\Omega_{OM}\right)_0 \approx 0.04341,\quad \left(\Omega_{DM}\right)_0 \approx 0.255$ and $\left(\frac{\left(K_{rot}\right)}{\frac{4\pi}{3}R^3}\right)_0 \approx 0.702 \sim 0.667$.

See the following Picture 3 for approximate cosmic density break up. Bottom curve (Blue line) represents approximate ordinary matter density, middle curve (Red line) represents the approximate dark matter density and top curve (green curve) represents approximate rotational kinetic energy density.



Picture 3. Approximate cosmic density break up

8. CONCLUSION

It may be noted that, currently believed 'modern cosmology' is not so standardized. Readers are strongly encouraged to see an excellent and very recent review on 'problems in modern cosmology' [42] in which practically all points of views are presented including mutually exclusive ones. We would like to stress the fact that, even though its believed proportion is around 70% and a number of surveys are going on to detect dark energy, so far, no one could find a single clue for tracing its physical identity or physical existence. In this identity crisis, it is reasonable to note that cosmic rotational kinetic energy seems to have more physical meaning and physical identity than the mysterious dark energy. In this context, it may also be noted that, quantum mechanics point of view, 'spin' is basic a characteristic and quantum gravity point of view, it is a must to review the currently believed 'standard cosmology'. In standard cosmology, there exists no definite relation in between estimated 'ordinary matter density' and estimated 'dark energy density'. In this toy model, by fitting the current ordinary matter density with current cosmic temperature and current Hubble parameter, we try to estimate current cosmic radius, current ordinary mass and its current rotational kinetic energy. Interesting point to be noted is that, without inflation, our toy model is coherent in fitting most of the observable current cosmic physical parameters. We appeal that, by incorporating 'inflation' concepts, our toy model assumptions and semi-empirical relations can be modified for better under-standing.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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