Modified Hubble's law and the primordial cosmic black hole

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Abstract

Part-1: It is noticed that $\frac{c^4}{G}$ is the classical limit of force and $\frac{c^5}{G}$ is the classical limit of power. For any rotating celestial body, the 3 critical conditions are : magnitude of 'kinetic energy' never crosses 'rest energy', magnitude of 'torque' never crosses 'potential energy' and magnitude of mechanical power never crosses $\left(c^5/G\right)$. With these conditions, mathematical complexity involved in GTR and black hole physics can be simplified. Now this is the time to re-examine the foundations of modern black hole physics. Planck mass can be derived very easily. Light speed rotating black hole's formation can be understood. Force $\frac{c^4}{G}$ keeps the light speed rotating black hole stable. It is noticed that, any elementary particle can escape from the light speed rotating black hole's equator. Origin of cosmic rays can be understood in this view. GTR and quantum mechanics can be coupled in a unified manner. Rotating black hole temperature formula can be derived very easily.

Part-2: The concept of 'dark energy' is still facing and raising a number of fundamental unresolved problems. 'Cosmic acceleration','dark energy' and 'inflation', are the results of Edwin Hubble's incomplete conclusions. If there is a misinterpretation in Hubble's law - flat model of cosmology can not be considered as a correct model of cosmology. **If the *primordial universe* is a natural setting for the creation of black holes and other nonperturbative gravitational entities, it is also possible to assume that throughout its journey, the whole universe is a *primordial cosmic black hole.*** Planck particle can be considered as the baby universe.

Part-3: Key assumption is that, "at any time, cosmic black hole rotates with light speed". Cosmic temperature is inversely proportional to the geometric mean of cosmic mass and planck mass. **For this growing cosmic sphere as a whole, while in light speed rotation, 'rate of decrease' in temperature is a "primary" measure of cosmic 'rate of expansion'**. It can be suggested that, 'rate of increase in galaxy red shift' from and about the cosmic center is a "secondary" measure of cosmic 'rate of expansion'. Present 'cosmic mass density' and 'cosmic time' are fitted with the natural logarithm of ratio of cosmic volume and planck particle's volume. If present CMBR temperature is isotropic at 2.725 ^{0}Kelvin, present angular velocity is 2.17 x 10^{-18} rad/sec = 67 Km/sec/Mpc.

Keywords: Classical limit of force, classical limit of power, light speed rotation, black hole, planck scale, light speed rotating black holes or special holes, cosmic ray, planck particle, baby universe, primordial cosmic black hole, **Unruh effect**, rate of decrease in CMBR temperature and rate of increase in cosmic redshift.

1 The cosmic 'axis of evil'

The cosmic "axis of evil is a name astrophysicists are giving to a newly discovered feature of our universe: a spiral pattern imprinted on radiation left over from the big bang. It has long been thought that matter is uniformly distributed throughout space, with no particular preference in any direction. Now there is new evidence (New Scientist, April 13, 2007) suggesting that the entire structure of the universe has the orientation of a corkscrew pattern: over 300 quasars fit into this overall whole twisting structure. Data from 1660 spiral galaxies also show the same overall orientation. If such a thing is true it would suggest that directionality, or anisotropy, rather than isotropy is the basis for galactic organization at the largest scale. Thus, the whole universe may in fact be based on spiral geometry, rather than being evenly spread out and uniform in all directions. So when you see or imagine spirals in your life, know that you are connecting to the most basic, fundamental structure of the whole universe.

1.1 The Universe: The new Axis of Evil - news from "The Independent", 01 February 2006

Ever since 1965, when two researchers at Bell Telephone Labs in New Jersey stumbled on it by accident, astronomers have known that the Universe is alive with the dim "afterglow" of the big bang fireball.

Now, something unexpected has cropped up in that afterglow - a feature dubbed "the axis of evil". Some think it is being caused by the gravity of a tremendous concentration of 100,000 galaxies in our cosmic backyard. Others say it is telling us there is something wrong with our big bang picture of the Universe.

The axis of evil is the biggest surprise thrown up by Nasa's Wilkinson Microwave Anisotropy Probe (WMAP). Launched on 30 June 2001, it has, from its vantage point 150 million kilometres beyond the Earth on the extension of the line joining our planet to the Sun, been taking the temperature of big bang afterglow, known as the "cosmic background radiation". Understanding exactly what WMAP has found requires a little diversion into the technicalities of the background radiation.

It is coming from every direction in the sky and its average temperature is minus 270C. Of key importance are subtle variations in temperature from place to place - "hot spots" that are ever-so-slightly warmer than average, and "cold spots" that are ever-so-slightly cooler.

These arise because the matter in the fireball of the big bang was slightly lumpy. (One lump became your home - the Milky Way.)

The hot spots and cold spots in the big bang afterglow come in all sizes. For instance, there are big blotches that stretch across much of the sky and, superimposed on these, smaller goosepimples.

To make sense of it all, astronomers like to break up their "temperature map" of the sky into manageable chunks they call "multipoles". The simplest is the "dipole" - merely one huge hot spot and one huge cold spot. It has nothing to do with the big bang. Rather, it is caused by the motion of the Milky Way, which is flying through space at about a million kilometres per hour. This makes the afterglow of the big bang appear hotter in the direction the Milky Way is flying and colder in the opposite direction.

The second simplest chunk of the cosmic background radiation is the "quadrupole". This is like the dipole, but is made up of two hot regions and two cold regions. Next comes the "octupole", which is comprised of three hot regions and three cold regions.

The simplest multipole chunks of the big bang radiation correspond to the biggest blotches, the more complex to the smallest freckles.

If the standard big bang picture of the Universe is correct, the blotches and freckles should be scattered randomly about the sky. "The big surprise is they are not," says Chris Vale of the University of California at Berkeley. "The quadrupole and octupole blotches are aligned with each other - along the axis of evil."

Nobody knows why. Could it be that all our preconceived notions about the big bang are wrong, or is it something less challenging? Vale leans towards the latter. He notes that the dipole direction is at right angles to the direction of the axis of evil. Recall that the dipole direction has nothing to do with the big bang, whereas the axis direction does, so their positions should not be related. "The fact that they are hints at an unexpected connection," says Vale.

According to Vale, if there is a giant concentration of mass in the local universe, its tremendous gravity could be distorting the cosmic background. The phenomenon is known as "gravitational lensing". It could cause the big hot spot of the dipole to "spill over" into the smaller hot spots. "The dipole hot spot is several hundred times hotter than the quadrupole," says Vale. "So it is not necessary for much to spill over to explain the axis of evil." Vale claims the best candidate for the local mass concentration is the "Shapley Supercluster" in our cosmic backyard, which contains 100,000 galaxies. It is not visible to the naked eye, despite covering at least 1,000 times the apparent size of the full Moon.

Other astronomers think Vale could be on to something. "Vale's model generates a good match of what we see," says WMAP scientist Gary Hinshaw of the Goddard Space Flight Center in Greenbelt, Maryland. "It's

remarkable."

However, some physicists wonder whether the axis of evil requires a rethink of our ideas about the Universe. They include Joao Magueijo at Imperial College in London, who coined the term "the axis of evil". According to Magueijo, there may be something seriously wrong with our big bang models.

Big bang models come out of Einstein's theory of gravity. The only way theorists can apply the hideously complicated theory to the Universe is to make two simplifying assumptions. One is that the Universe is roughly the same in all places, and the other is that it is roughly the same in all directions.

But if the Universe is the same in all directions, as the big bang models require, that means that the hot spots and cold spots in the afterglow of the big bang should be randomly splattered about the sky - the big temperature splotches and the small temperature goose pimples should have no preferred direction. The fact that they are aligned along the axis of evil leads Magueijo to suggest that maybe the assumptions behind the big bang models are wrong. In other words, the Universe is not the same in all places or directions, but has a special direction.

According to Magueijo, there are a number of ways the Universe could have a special direction. One is if we live in a "slab universe". This is a Universe in which space is infinite in two directions but in the other is only about 20 billion light years across - the diameter of the observable universe. Another possibility is that we live in torus-shaped universe, like a giant ring doughnut. Yet another is that Universe is spinning. But how would could such a weird state of affairs have arisen? "That's the big question," Magueijo says.

So perplexing is the axis of evil that Hinshaw and WMAP's principal investigator, Chuck Bennett, have obtained a grant for a five-year examination of the WMAP data. They hope to explore the possibilities that the WMAP instrument was in error, or that something else went wrong. "There's no question there's stuff that looks unusual," says Bennett.

We will have to wait and see whether the study reveals the axis of evil to be a cosmic mirage, or shows the big bang model to be in serious trouble.

1.2 Astronomers Reveal a Cosmic 'Axis of Evil' - news from Royal Astronomical Society, 2011 June 30

Astronomers are puzzled by the announcement that the masses of the largest objects in the Universe appear to depend on which method is used to weigh them. The new work was presented at a specialist discussion meeting on 'Scaling Relations of Galaxy Clusters' organised by the Astrophysics Research Institute (ARI) at Liverpool John Moores University and supported by the Royal Astronomical Society.

Clusters of galaxies are the largest gravitationally bound objects in the Universe containing thousands of galaxies like the Milky Way and their weight is an important probe of their dark matter content and evolution through cosmic time. Measurements used to weigh these systems carried out in three different regions of the electromagnetic spectrum: X-ray, optical and millimetre wavelengths, give rise to significantly different results.

Eduardo Rozo, from the University of Chicago, explained that any two of the measurements can be made to fit easily enough but that always leaves the estimate using the third technique out of line. Dubbed the 'Axis of Evil', it is as if the Universe is being difficult by keeping back one or two pieces of the jigsaw and so deliberately preventing us from calibrating our weighing scales properly.

More than 40 of the leading cluster astronomers from UK, Europe and the US attended the meeting to discuss the early results from the Planck satellite, currently scanning the heavens at millimetre wavelengths, looking for the smallest signals from clusters of galaxies and the cosmic background radiation in order to understand the birth of the Universe. The Planck measurements were compared with optical images of clusters from the Sloan Digitised Sky Survey and new X-ray observations from the XMM-Newton satellite.

ARI astronomers are taking a leading role in this research through participation in the X-ray cluster work and observations of the constituent galaxies using the largest ground-based optical telescopes.

One possible resolution to the 'Axis of Evil' problem discussed at the meeting is a new population of clusters which is optically bright but also X-ray faint. Dr Jim Bartlett (Univ. Paris), who is one of the astronomers who presented the Planck results, argued that the prospect of a new cluster population which responds differently was a 'frightening prospect' because it overturns age old ideas about the gravitational physics being the same from cluster to cluster.

Chris Collins, LJMU Professor of Cosmology, who organised the meeting said: 'I saw this meeting as an opportunity to bring together experts who study clusters at only one wavelength and don't always talk to their colleagues working at other wavelengths. The results presented are unexpected and all three communities (optical, X-ray and millimetre) will need to work together in the future to figure out what is going on'.

2 Disclosure

Most of the information included in this article has been previously published [1] in the paper "Physics of Rotating and Expanding Black Hole Universe", Progress in Physics, vol. 2, April, 2010, p. 7-14. The main concepts of the paper are: 'rate of decrease in CMBR' temperature is a measure of cosmic 'rate of expansion' and through out its journey, universe is an expanding and (light speed) rotating black hole [2]. This article is its revised version. **In this article it is suggested that universe can be considered as the primordial cosmic black hole**.

Existence of dark matter, dark energy, inflation and the accelerating universe - these four concepts are having only indirect support and can be considered as 'enigmatic concepts'. Their root was originated in 1929 from Edwin Hubble's incomplete interpretations [3, 4]. For the same observations it is also possible to reinterpret as: 'rate of increase in redshift' is a measure of cosmic rate of expansion. With this idea, automatically a closed expanding and rotating model of universe comes into picture. With the above four enigmatic concepts (directly and indirectly) GTR is loosing its original identity from the rest of the physics world. But this is the time to think about the unification of GTR and quantum mechanics. In this critical situation, one very interesting theoretical idea is - now a days to understand the origin of dark matter and galaxy growth, physicists are focussing their concentration on primordial cosmic black holes. One interesting observation is : central galactic black holes are spinning close to speed of light [5]. Even though these two are also enigmatic concepts, GTR and quantum mechanics can be studied in a unified manner.

Published papers [6-9] clearly indicates that, current cosmological observations can be understood with the black hole concepts and the possibility of a model of black hole cosmology is not far away from reality. Interesting research work on black hole cosmology can be seen in physics literature [10-14]. In a unified approach it is noticed that $\frac{c^4}{G}$ is the classical limit of force and $\frac{c^5}{G}$ is the classical limit of power.

2.1 Light speed rotation - an unified enigmatic concept

All these enigmatic concepts can be unified into one enigmatic concept. That is - light speed rotation [15, 16]. Its important and immediate applications are

1. Classical limits of force and power can be generated.
2. GTR and quantum mechanics can be studied in a unified manner.
3. Origin of the planck scale can be understood.
4. A closed rotating and expanding model of the universe can be developed.
5. The two experimental numbers CMBR temperature and cosmic expansion rate can be interrelated in a unified way.
6. Finally a unified black hole model of cosmology can be developed.

3 Classical limits of force and power

Special theory of relativity says that light speed is the maximum speed that a material particle can move with. It is the natural speed with which photon or electromagnetic signal travels in free space. Till today there is no explanation for this characteristic speed limit. Throughout the cosmic evolution whether the speed limit is constant or changing? is also an answerless question. It is an accepted and universal idea that 'gravity' and 'gravitational radiation' also propagates with speed of light.

Dimensionally and physically a characteristic force form can be obtained with speed of light (c) and Newton's gravitational constant (G). It can be expressed as $\left(c^4/G\right)$. It can be considered as the 'classical limit' of 'force' [17-20]. It represents the maximum 'gravitational force of attraction' and maximum 'electromagnetic force'. It plays an important role in 'unification' scheme. It is the origin of "Planck scale". It is the origin of 'Quantum gravity'. Similar to this 'classical force', classical limit of 'power' can be given by $\left(c^5/G\right)$. It plays a crucial role in 'gravitational radiation'. It represents the 'maximum limit' of 'mechanical' or 'electromagnetic' power and 'radiation power'. $\left(c^4/G\right)$ can be derived based on 'Newton's law of gravitation' and 'constancy of speed of light'. In Sun-Planet system, from Newton's law of gravitation,

$$F_g = \frac{GM_S m_P}{r^2} \tag{1}$$

Here, M_S= mass of sun, m_P=mass of planet and r = distance between them. Centripetal force on planet is,

$$F_c = \frac{m_P v^2}{r} \tag{2}$$

where, v = orbiting velocity of planet. Eliminating r from equation (2), force of attraction between sun-planet can be given as,

$$F = \left(\frac{m_P}{M_S}\right)\left(\frac{v^4}{G}\right) \tag{3}$$

It is very clear that, since (m_P/M_S) is a ratio, (v^4/G) must have the dimensions of 'force'. Following the 'constancy of speed of light', a force of the form, $\left(c^4/G\right)$ can be constructed. This can be considered as the upper limit or magnitude of any force. Nature of the force may be mechanical or electromagnetic or gravitational. Note that in GTR this force appears in an inverse form [21] as

$$\frac{1}{F}=\frac{8\pi G}{c^4} \tag{4}$$

Considering this magnitude as the upper limit of gravitational force of attraction minimum distance between any 2 massive bodies can be obtained as follows. Let,

$$\frac{Gm_1m_2}{r^2}\leq\frac{c^4}{G} \tag{5}$$

Here, m_1 and m_2 are any 2 massive bodies and r is distance between them. Then minimum distance between the 2 bodies can be obtained as

$$r_{\min}=\frac{G\sqrt{m_1m_2}}{c^2} \tag{6}$$

This is a simple very strange expression. By any chance if mass of the 2 bodies is equal then

$$r_{\min}=\frac{Gm}{c^2} \tag{7}$$

Without going deep into general theory of relativity and combining Newton's law of gravitation and Special theory of relativity, results of GTR can be obtained. This idea can be applied to elementary particles also. Magnitude of force of attraction or repulsion between any 2 elementary particles having charges e_1 and e_2 can be expressed as

$$F=\frac{e_1e_2}{4\pi\varepsilon_o r^2}\leq\frac{c^4}{G} \tag{8}$$

Minimum distance between e_1 and e_2 can be obtained as

$$r_{\min}=\sqrt{\frac{e_1e_2}{4\pi\varepsilon_o}\left(\frac{G}{c^4}\right)}=\sqrt{\frac{e^2}{4\pi\varepsilon_o}\left(\frac{G}{c^4}\right)} \tag{9}$$

where $e_1=e_2=e$. Charged particle's space-time curvature can be understood from this expression. With this idea GTR can be applied to charged elementary particles easily. Not only that this method simply and directly leads to planck scale and grand unification or TOE. Grand unification assumes that in the past the observed 4 fundamental interactions are same and having the same strength. Magnitude of the force at that time can be taken as c^4/G. With a suitable proportionality ratio quark confinement can be understood as a charged space-time curvature. Clearly speaking 'gravity' can be implemented very easily in nuclear and quark physics [22-25]. From quantum mechanics

$$\frac{e^2}{4\pi\varepsilon_o\hbar c}=\alpha\quad\text{and}\quad\frac{e^2}{4\pi\varepsilon_o}=\alpha\hbar c \tag{10}$$

From above equation it is noticed that

$$r_{\min}=\sqrt{\alpha\hbar c\left(\frac{G}{c^4}\right)}=\sqrt{\alpha\left(\frac{G\hbar}{c^3}\right)} \tag{11}$$

This length is smaller than the planck length by $\sqrt{\alpha}$.

4 Origin of the Planck scale

Assume that 2 planck particles having mass M_P moving in opposite direction and coming closer and closer. At some minimum distance their magnitude of gravitational force of attraction approaches

$$\frac{GM_PM_P}{r_{\min}^2}=\frac{c^4}{G} \tag{12}$$

If mass of planck particle is M_P,

$$M_P=\frac{hc}{\lambda_P}, \tag{13}$$

From wave mechanics, if

$$2\pi.r_{\min}=\lambda_P \tag{14}$$

$$\frac{GM_PM_P}{r_{\min}^2}=\frac{c^4}{G}=\frac{G\hbar^2}{r_{\min}^4c^2} \tag{15}$$

$$\therefore r_{\min}=\sqrt{\frac{G\hbar}{c^3}}\quad\text{and}\quad 2\pi.r_{\min}=\lambda_P=2\pi\sqrt{\frac{G\hbar}{c^3}} \tag{16}$$

Rest energy of planck particle can be given as

$$M_Pc^2=\frac{hc}{\lambda_P}=\sqrt{\frac{\hbar c^5}{G}}=\sqrt{\hbar c\left(\frac{c^4}{G}\right)} \tag{17}$$

Mass of planck particle is

$$M_P=\sqrt{\frac{\hbar c}{G}} \tag{18}$$

Here the fundamental questions to be answered are

1. Is planck particle obeys particle nature?
2. Is planck particle a photon or a baryon?
3. Is planck particle follows strong gravity?
4. What is the mass range of black holes?

If the planck particle is not a real massive particle just like a photon it can be easily implemented in the early cosmology. It can be considered as the mass of the baby universe. Big bang model assumes that in the early phase matter was in the form of radiation. If one consider planck photon as the baby universe its characteristic mass can be considered as the basic or characteristic mass of the baby universe. Thus qualitatively and quantitatively the planck photon couples GTR, quantum mechanics and big bang cosmology.

5 The planck mass and the coulomb mass

With this classical limit of force $\left(c^4/G\right)$, similar to the planck mass-energy 'coulomb mass-energy' can be expressed as

$$M_C c^2 = \sqrt{\alpha} \times \sqrt{(\hbar c)\left(\frac{c^4}{G}\right)} = \sqrt{\left(\frac{e^2}{4\pi\varepsilon_o}\right)\left(\frac{c^4}{G}\right)} \quad (19)$$

$$M_C = \sqrt{\alpha} \times \sqrt{\frac{\hbar c}{G}} = \sqrt{\frac{e^2}{4\pi\varepsilon_o G}} \quad (20)$$

Here 'e' is the elementary charge and (c^4/G) is the classical limit of force. How to interpret this mass unit? Is it a primordial massive charged particle? If 2 such oppositely charged particles annihilates, a large amount of energy can be released. Considering so many such pairs annihilation hot big bang or inflation can be understood. This may be the root cause of cosmic energy reservoir. Such pairs may be the chief constituents of black holes. In certain time interval with a well defined quantum rules they annihilate and release a large amount of energy in the form of γ photons [26].

It is widely accepted that charged leptons, quarks, and baryons all these comes under matter or mass carriers and photons and mesons comes under force carriers. If so what about this new mass unit? is it a fermion? or is it a boson? or else is it represents a large potential well in the primordial matter or mass generation program? Is it the mother of magnetic monopoles? Is it the mother of all charged particles? By any suitable proportionality ratio or with a suitable scale factor if one is able to bring down its mass to the observed particles mass scale, very easily a grand unified model can be developed [22-25].

6 Light speed rotating Black Holes : The special holes

Origin of 'rotating black hole' formation can understood with the classical power limit $\left(c^5/G\right)$ and $\left(\mathrm{Mc}^2\right)$ within 3 steps as, for any rotating celestial body assume that,

$$\text{torque}, \tau \leq Mc^2 \quad (21)$$

$$\text{power}, P = \tau\omega \leq \frac{c^5}{G} \quad (22)$$

Hence

$$\omega \leq \frac{c^3}{GM} \quad \text{and} \quad \omega_{\max} = \frac{\mathrm{c}^3}{\mathrm{GM}} \quad (23)$$

When the celestial body rotates at light speed, to have maximum angular velocity, size should be minimum as,

$$R_{min} = \frac{c}{\omega_{max}} = \frac{GM}{c^2} \quad (24)$$

This expression is similar to the 'Schwarzschild radius' of a black hole [27, 28]. The only change is that coefficient 2 is missing. This is really a very interesting case. This obtained expression indicates that, to get 'light speed rotation', celestial body should have a 'minimum size' of $\frac{GM}{c^2}$. Clearly speaking this proposal is entirely different from the existing concepts of General theory of relativity. It is not speaking about the gravitational collapse of stars or space-time curvature or singularity. Now this is the time to re-examine the foundations of modern black hole physics. It can be suggested that, the subject of 'black hole physics' has to be studied in a new direction. If the concept of 'Schwarzschild radius' is believed to be true, for any rotating celestial body or black hole of rest mass (M) the critical conditions can be stated as follows.

1. **Magnitude of 'kinetic energy' never crosses 'rest energy'**.
2. **Magnitude of 'torque' never crosses 'potential energy'** and
3. **Magnitude of mechanical power never crosses** $\left(c^5/G\right)$.

Based on Virial theorem, potential energy is twice of kinetic energy and hence,$\tau \leq 2Mc^2$. In this way factor 2 can be obtained easily from equations (21), (22) and (23). Not only that special theory of relativity, classical mechanics and general theory of relativity can be studied in a unified way. Such light speed rotating black holes may be called as 'special holes'.

7 Derivation for black hole temperature

Dr. Stephen Hawking [29] says- "*The main difficulty in finding a theory that unifies gravity with the other*

forces is that general relativity is a "classical" theory; that is, it does not incorporate the uncertainty principle of quantum mechanics. On the other hand, the other partial theories depend on quantum mechanics in an essential way. A necessary first step, therefore, is to combine general relativity with the uncertainty principle. As we have seen, this can produce some remarkable consequences, such as black holes not being black, and the universe not having any singularities but being completely self-contained and without a boundary

Einstein's general theory of relativity seems to govern the large-scale structure of the universe. It is what is called a classical theory; that is, it does not take account of the uncertainty principle of quantum mechanics, as it should for consistency with other theories. The reason that this does not lead to any discrepancy with observation is that all the gravitational fields that we normally experience are very weak. However, the singularity theorems discussed earlier indicate that the gravitational field should get very strong in at least two situations, black holes and the big bang. In such strong fields the effects of quantum mechanics should be important. Thus, in a sense, classical general relativity, by predicting points of infinite density, predicts its own downfall, just as classical (that is, non quantum) mechanics predicted its downfall by suggesting that atoms should collapse to infinite density. We do not yet have a complete consistent theory that unifies general relativity and quantum mechanics, but we do know a number of the features it should have.

A black hole of mass (M) having size, $R = \frac{2GM}{c^2}$ rotates with an angular velocity (ω) and rotational speed ($v = R\omega$). Assume that, its temperature (T) is inversely proportional to its rotational time period(t). Keeping '**Law of uncertainty'** in view, assume that,

$$(k_B T) * t = \frac{h}{4\pi} = \frac{\hbar}{2} \tag{25}$$

$$\text{(Or)} \quad T * t = \frac{h}{4\pi k_B} = \frac{\hbar}{2k_B} \tag{26}$$

Here, t = rotational time period and T = Temperature, k_B = Boltzmann's radiation constant, h = Planck's constant and $\left[\left(\frac{k_B T}{2}\right) + \left(\frac{k_B T}{2}\right)\right] = k_B T$ is the sum of kinetic and potential energies of a particle in any one direction. We know that,

$$t = \frac{2\pi}{\omega} = \frac{2\pi R}{v} = \frac{4\pi GM}{c^2 v} \tag{27}$$

Hence,

$$T = \frac{\hbar c^2 v}{8\pi GM k_B} \tag{28}$$

It is very surprising to say that – a small physical constant is influencing a big massive body. If the black hole rotational speed (v) approaches light speed(c), then temperature reaches to maximum. Here author's humble appeal is : force limit $\left(c^4/G\right)$ keeps the black hole 'stable or rigid' even at light speed rotation.

$$v \ \to v_{\max} \to c, \quad T = \frac{\hbar c^3}{8\pi GM k_B} \cong T_{\max} \tag{29}$$

Please note that, this idea or assumption couples GTR and quantum mechanics successfully. Hawking's black hole temperature formula can be obtained easily. And its meaning is simple and there is no need to consider the pair particle creation for understanding 'hawking radiation'. Conceptually this can be compared with the famous **Unruh effect** [30]. It is the prediction that an accelerating observer will observe black-body radiation where an inertial observer would observe none. The Unruh temperature, derived by William Unruh in 1976, is the effective temperature experienced by a uniformly accelerating detector in a vacuum field. Its mathematical expression is

$$T = \frac{\hbar a}{2\pi c k_B} \tag{30}$$

where a is the local acceleration. If one is willing to replace the 'linear acceleration' with the 'angular acceleration' of the rotating black hole, then 'black hole temperature' comes into picture.

7.1 Hawking's Black hole temperature formula demands light speed rotation

From the above discussion it is very clear that, origin of Hawking radiation is possible in another way also. But it has to be understood more clearly. Information can be extracted from a black hole, if it rotates with "light speed". If a black hole rotates at 'light speed', photons or elementary particles can escape from its 'equator only' with light speed and in the direction of black hole rotation and this seems to be a signal of "Black hole radiation" around the black hole equator. *With this idea origin of cosmic rays can also be understood.* Please note that, not only at the black hole equator, Hawking radiation can take place at the event horizon of the black hole having a surface area. This equation (29) is identical to the famous expression derived by Hawking. Since the black hole temperature formula is accepted by the whole science community, author humbly requests the modern scientists to kindly look into this major conceptual clash at utmost fundamental level.

Temperature of any black hole is very small and may not be found experimentally. But this idea can successfully be applied to the Universe! By any reason if it is assumed that, Universe is

a black hole, then it seems to be surprising that, temperature of a stationary cosmic black hole is "zero". Its temperature increases with increase in its rotational speed and reaches to maximum if the rotational speed of the cosmic black hole approaches 'light speed". This is the essence of cosmic black hole rotation. CMBR temperature demands the existence of "cosmic rotation". This is the most important point to be noted here.

7.2 Planck particle and its light speed rotation

If planck particle or planck photon follows strong gravity and rotates at light speed, obtained planck mass,

$$M_P = \sqrt{\frac{\hbar c}{G}} = 2.176436 \times 10^{-8} \text{ Kg} \tag{31}$$

Obtained Planck size

$$R_P = \left(\frac{2GM_P}{c^2}\right) = 3.23251 \times 10^{-35} \text{ m} = 2\sqrt{\frac{G\hbar}{c^3}} \tag{32}$$

Obtained Planck angular velocity,

$$\omega_P = \frac{c}{R_P} = \frac{c^3}{2GM_P} = \frac{1}{2}\sqrt{\frac{c^5}{G\hbar}} = 9.2743 \times 10^{42} \ \frac{\text{rad}}{\text{sec}} \tag{33}$$

Obtained Planck temperature,

$$T_P \cong \frac{\hbar c^3}{8\pi G M_P k_B} \cong \frac{\hbar \omega_P}{4\pi K_B} = 5.63721 \times 10^{30} \ ^0\text{kelvin} \tag{34}$$

8 GTR, Planck mass and the CMBR temperature

Let us assume that present universe is a point particle having mass M_0. Assume that gravitational force of attraction between the point universe mass and the planck photon (the baby universe mass) is equal to $\left(c^4/8\pi G\right)$. Author humbly say- this simple assumption unifies GTR, quantum mechanics, planck scale, big bang cosmology and Hubble's observations.

$$\frac{GM_0M_P}{r_0^2} \cong \frac{c^4}{8\pi G} \tag{35}$$

From big bang model at any time expanding universe possess some temperature and its present CMBR temperature is $T_0 = 2.725^o$ Kelvin. Surprisingly it is noticed that, above assumption is satisfied at the following 2 conditions.

$$r_0 = \left(\frac{\lambda_m T}{2\pi T_0}\right) = \frac{2.898 \times 10^{-3}}{2\pi k_B T_0} = \frac{hc}{2\pi \times 4.965 k_B T_0} \ \text{meter} \tag{36}$$

$$M_0 = \frac{c^3}{2GH_0} \tag{37}$$

where H_0 is the present cosmic expansion rate index [32,33]. Above expression can be expressed as

$$T_0 = \frac{1}{\sqrt{8\pi * 4.965^2}} \frac{\hbar c^3}{G\sqrt{M_0M_P}} \cong \frac{\hbar c^3}{8\pi G k_B \sqrt{M_0M_P}} \tag{38}$$

Note that, $\sqrt{8\pi * 4.965^2} \cong 24.891 \cong 8\pi = 25.13274123$. Hence

$$T_0 \cong \frac{\hbar}{4\pi k_B}\sqrt{\frac{c^3}{2GM_P} \times \frac{c^3}{2GM_0}} \tag{39}$$

There is no working boundary in the flat model cosmology. It is an usual and widespread practice to say that $\left({}^{c}/_{H_0}\right)$ is the characteristic length of the universe and is called as the Hubble radius. Not only that Hubble volume $\frac{4\pi}{3}\left(\frac{c}{H_0}\right)^3$ represents the characteristic and observable volume of the universe .

It is defined and accepted that H_0 value changes with time. Cosmic temperature also changes with time. By any chance if one is able to consider $\frac{c^3}{2GM_0}$ as the present angular velocity, $\frac{c^3}{2GM_P}$as the planck photon angular velocity then above relation can be expressed as

$$4\pi k_B T_0 \cong \hbar\sqrt{\omega_P \omega_0} \tag{40}$$

This is definitely possible only if universe follows strong gravity and light speed rotation. During the cosmic evolution, at any time above equation can be re-expressed as

$$4\pi k_B T_t \cong \hbar\sqrt{\omega_P \omega_t} \tag{41}$$

The surprising and interesting idea is for the baby universe or for the planck photon $\omega_t = \omega_P$. Hence

$$4\pi k_B T_t \cong \hbar\omega_P \tag{42}$$

This procedure may be ad-hoc. But beauty of this procedure is that it couples

1. Newton's law of gravitation,
2. Einstein's cosmic force constant,
3. Wein's displacement law and
4. Special theory of relativity (for constancy of light speed).

9 Modified Hubble's law

Ever since the late 1920's, when Edwin Hubble discovered a simple proportionality between the redshifts in the light coming from nearby galaxies and their distances,

we have been told that the Universe is expanding. Hubble found the recession speed v of a nearby galaxy was related to its radial distance r, $v = H_0 r$, where H_0 is the constant of proportionality [3]. This relationship- dubbed the Hubble law- has since been strengthened and extended to very great distances in the cosmos.This was the incomplete interpretation that changed the destiny of the modern cosmology. Based on this interpretation modern cosmologists arrived at the conclusion that - at present, universe is flat and is accelerating. Nowadays it is considered to be well established in the expanding big bang universe. Hubble initially interpreted his redshifts as a Doppler effect, due to the motion of the galaxies as they receded for our location in the Universe. He called it a 'Doppler effect' as though the galaxies were moving 'through space'; that is how some astronomers initially perceived it. This is different to what has now become accepted but observations alone could not distinguish between the two concepts.

Later in his life Hubble varied from his initial interpretation [4] and said that the Hubble law was due to a hitherto undiscovered mechanism, but not due to expansion of space - now called cosmological expansion. In this connection, author humbly says - there was something wrong and missing in Hubble's interpretation. For the same observations it can also be possible to state that, in a closed and expanding universe, from and about the cosmic center, rate of increase in galaxy redshift is a measure of cosmic rate of expansion. This statement includes 3 points.

1. Light from the galaxy travels opposite to the direction of cosmic expansion and shows redshift and thus redshift is a measure of galaxy distance from the cosmic center.

2. In the expanding universe, increase in redshift is instantaneous due to instantaneous increase in galaxy distance (which is due to instantaneous increase in cosmic volume).

3. Rate of increase in redshift indicates the cosmic rate of expansion.

9.1 Cosmic acceleration, rate of decrease in CMBR temperature, isotropy and rotation

1. After the big bang, since 5 billion years if universe is "accelerating" and at present dark energy is driving it- right from the point of big bang to the visible cosmic boundary in all directions, thermal photon wavelength must be stretched instantaneously and continuously from time to time and cosmic temperature must decrease instantaneously and continuously for every second. This is just like "rate of stretching of a rubber band of infinite length". Note that photon light speed concept is not involved here. Against to this idea since 1992 from Cobe satellite's CMBR data reveals that cosmic temperature is practically constant at 2.726 °K. This observational clash clearly indicates that something is going wrong with accelerating model. Moreover the standard model predicts that the cosmic background radiation should be cooling by something like one part in 10^{10} per year. This is at least 6 orders of magnitude below observable limits. Such a small decrease in cosmic temperature might be the result of cosmic "slowing down" rather than cosmic acceleration. Technically from time to time if we are able to measure the changes in cosmic temperature then 'rate of decrease' in cosmic temperature will give the 'rate of increase' in cosmic expansion accurately. Author humbly requests the Indian Space Research Organization (ISRO) to launch a satellite for measuring the 'rate of decrease' in CMBR temperature.

2. Based on this analysis if "cosmic constant temperature" is a representation of "isotropy" it can be suggested that at present there is no acceleration and there is no space expansion and thus universe is static. From observations it is also clear that universe is homogeneous in which galaxies are arranged in a regular order and there is no mutual attraction in between any two galaxies. Not only that Hubble's observations clearly indicates that there exists a linear relation in between galaxy distance and galaxy speed (which might be a direct consequence of "cosmic rotation" with "constant speed"). This will be true if it is assumed that "rate of increase in red shift" is a measure of cosmic "rate of expansion". Instead of this in 1929 Hubble interpreted that "red shift" is a measure of cosmic "expansion". This is the key point where Einstein's static universe was discarded.

3. At present if universe is isotropic and static how can it be stable? The only one solution to this problem is "rotation with constant speed". If this idea is correct, universe seems to follow a closed model. At present if universe rotates as a rigid sphere with constant speed then galaxies will revolve with speeds proportional to their distances from the cosmic axis of rotation. Hence the Hubble's law must be re-interpreted as "at present as galaxy distance increases its revolving speed increases". If so H_0 will turn out to be the present

angular velocity. In this way cosmic stability and homogeneity can be understood.

4. This "constant speed cosmic rotation" can be extended to the big bang also. As time passes while in constant speed of rotation some how if the cosmic sphere expands then "galaxy receding" as well as "galaxy revolution" both will come into picture. In the past while in constant speed of rotation at high temperatures if expansion is rapid for any galaxy (if born) receding is rapid and photon from the galaxy travels towards the cosmic center in the opposite direction of space expansion and suffers a continuous fast rate of stretching and there will be a continuous fast rate of increase in red shift. At present at small temperatures if expansion is slow galaxy receding is small and photon suffers continuous but very slow rate of stretching and there will be a continuous but very slow rate of increase in red shift i.e. red shift practically remains constant. From this analysis it can be suggested that rate of decrease in cosmic temperature or rate of increase in red shift will give the rate of cosmic expansion. In the past we have galaxy receding and at present we can have galaxy revolution. By this time at low temperature and low angular velocity, galaxies are put into stable orbits.

9.2 Cosmic closed model and rotation

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. By any reason, if the closed boundary is opened it leads to 'destruction' rather than 'growth or expansion'. Rotation is an universal phenomenon[34 - 43] in any closed model.

9.3 Universe - the primordial black hole

Thinking that nature loves symmetry, in a heuristic approach in this paper author assumes that, throughout its life time, universe is a black hole. Even though it is growing, at any time it is having a closed boundary and thus it retains her identity as a black hole forever. The subject of black hole cosmology is not new. Note that universe is an independent body. It may have its own set of laws. If universe is having 'no black hole structure', any massive body (which is bound to the universe) may not show a 'black hole structure'. i.e 'Black hole structure' may be a sub set of 'cosmic structure'. Recent observations indicates that, black holes are spinning close to speed of light [5]. For any astrophysical body its size is minimum if it follows strong gravity. Being an astrophysical body at any time to have a minimum size of expansion- universe will follow strong gravity. Following a closed model if universe grows in mass and size it is natural to say that as time is passing cosmic black hole is "growing or expanding".

Clearly and strictly speaking there was no big bang at all. Highly dense, hot and tiny planck particle (the baby universe) was rotating with light speed and high angular velocity. Why, how and when the planck particle was born? is a trillion dollar question to be answered. As time is passing, forever rotating at light speed the baby universe starts growing with decreasing temperature, decreasing angular velocity, increasing size and increasing mass. At what rate the changes are occurring? is a fundamental question to be answered. By observations and suitable analysis it is possible. The utmost fundamental question to be answered is – is planck particle a black hole? If it is a really a black hole certainly it possess an intrinsic or a characteristic (high) temperature. Keeping this idea in mind if one proceeds further concepts of isotropy, homogeneity can be answered very easily. Inflation hypothesis can be eliminated. A unified model of black hole cosmology can be developed. But the subject of black holes is still under development. So many doubts and conflicts are there about the formation and growth of galactic central black holes and galaxy as a whole [44,45,46].

9.4 Growth of galactic central black holes

Now as recently reported at the American Astronomical Society a study using the Very Large Array radio telescope in New Mexico and the French Plateau de Bure Interferometer has enabled astronomers to peer within a billion years of the big bang and found evidence that black holes were the first that leads galaxy growth [44]. The implication is that the black holes started growing first. Initially astrophysicists attempted to explain the presence of these black holes by describing the evolution of galaxies as gathering mass until black holes form at their center but further observation demanded that the galactic central black hole co-evolved with the galactic bulge plasma dynamics and the galactic arms. This clearly suggests that

1. Galaxy constitutes a central black hole.

2. The central black hole grows first and

3. Star and galaxy growth goes parallel or later to the central black holes growth.

The fundamental questions are -

1. If "black hole" is the result of a collapsing star, how and why a stable galaxy contains a black hole at its center?
2. Where does the central black hole comes from?
3. How the galaxy center will grow like a black hole?
4. How its event horizon exists with growing?

If these are the observed and believed facts - not only for the author- this is a big problem for the whole science community to be understood. Any how, the important point to be noted here is that "due to some unknown reasons galactic central black holes are growing"! In this critical situation, now a days scientists are seriously thinking about the origin and growth of primordial balck holes [6].

9.5 The primordial black holes

A primordial black hole is a hypothetical type of black hole that is formed not by the gravitational collapse of a large star but by the extreme density of matter present during the universe's early expansion. One way to detect primordial black holes is by their Hawking radiation. Stephen Hawking theorized in 1974 that large numbers of such smaller primordial black holes might exist in the Milky Way in our galaxy's Halo region. All black holes are believed by many theorists to emit Hawking radiation at a rate inversely proportional to their mass. Since this emission further decreases their mass, black holes with very small mass would experience runaway evaporation, creating a massive burst of radiation at the final phase, equivalent to millions of one-megaton hydrogen bombs exploding. This explanation is, however, considered unlikely. Other problems for which primordial black holes have been suggested as a solution include the dark matter problem, the cosmological domain wall problem and the cosmological monopole problem. Primordial black holes in the mass range 10^{14} kg to 10^{23} kg may also have contributed to the later formation of galaxies. This is due to the possibility that at this low mass they would behave as expected of other particle candidates for dark matter. As of today there is no solid evidence for the existence of PBHs, but their presence would be very difficult to detect even if they constitute the bulk of the dark matter. A black hole with a mass of about 10^{11} kg would have a lifetime about equal to the age of the universe. Based on the present theoritical works, expected mass of the nonevaporating PBHs ranges from $M \geq \left(0.1 \text{ to } 10^5\right) \times M_S$. PBHs with masses $M \cong M_S$ may form during the QCD (quark-hadron) phase transition at $t \cong 10^{-5}$ seconds, or PBHs with mass $10^5 \times M_S$ may form during the e^+, e^- annihilation era. **If universe is natural setting for the origin of primordial black holes- to understand the cosmological observations and black hole physics in a unified manner, it can be assumed that, right from the beginning to the present state, whole universe is a primordial black hole**.

9.6 The cosmological principle and the closed expanding universe

It may be a flat universe or closed universe, why universe is/was filled with thermal bath? is a million dollar question. If it is a black hole this question can be answered partially. The cosmological principle states that at any given cosmic time universe is homogeneous and isotropic. Compared to a flat model, isotropy is more natural in a closed expanding universe. Considering the closed expanding universe this can be very easily understood. In a closed expanding universe the utmost important and interesting point is that as the closed universe is expanding its thermal waves are stretched by the closed cosmic boundary in opposite directions simultaneously. As long as the closed universe is expanding instantaneously thermal waves undergo continuous stretching and results in instantaneous isotropy or thermal equilibrium. This is just like stretching of a rubber band with both the hands in opposite directions.

In a flat universe there exists no working boundary and hence stretching of the thermal waves in opposite directions may not be possible instantaneously. Hence isotropy or thermal equilibrium cannot be maintained instantaneously in a flat model. Even the possibility of a proper physical coupling or contact in between the thermal bath and the flat cosmic volume is doubtful. Inflation may be required in a flat model but not required for the closed expanding model. Even in particle physics also there is no clear and solid mechanism for the initiation of inflation. More over inflation or exponential expansion of cosmic space violates the constancy of speed of light. Please note that at present there is no fundamental theory for the inflationary universe. With this discussion any one can confidently say that - the notion of 'flat accelerating universe' is incorrect. Note that present 'accelerating model' and 'dark energy' both are the consequences of 'flat model' [47, 48, 49]. Hence their survival seems to be ad-hoc and uncertain [50, 51, 52].

The new SNe distance determinations do not state that the expansion of the universe is accelerating nor that there is some kind of "antigravity" effect, nor that there is some new substance. The data only forces the

conclusion that there is a problem in the purely Hubble conception of the cosmos or at least in the Hubble-based method of determining the distance to distant objects. Present observational or experimental data indicates that cosmic microwave back ground radiation temperature is 2.725 ^{0}kelvin [53, 54]. It is very uniform up to several mega parsecs from Earth and so smooth to one part in 100000.

10 The beginning of Black hole cosmology

Concept of cosmic rotation is not new. The subject of cosmic strong gravity is also not new. The only ad-hoc and speculative idea (from accelerating model point of view but not from the black hole physics point of view) of this model is cosmic light speed rotation. Till today there is no explanation for constancy of speed of light. Recent observations indicates that galactic central black holes are spinning close to the speed of light! Really this is a surprise. Not only that present observations confirms that the galactic central black holes co-evolved with the galactic bulge plasma dynamics and the galactic arms. With these fascinating observations one cannot say that, the idea of cosmic light speed rotation is a speculative concept in fundamental physics. It will be a very interesting and challenging task for a mathematician or physicist to describe the light speed cosmic space rotation. Compared to the other models of cosmology like hot big bang, inflation, accelerating universe, this model is free from speculative concepts like exponential expansion, hot big bang and dark energy. From fundamental physics point of view really and certainly these are speculative concepts. In real life or at least in a laboratory one cannot experience these concepts. Whereas the concept of light speed is an observable and measurable one.

In grand unification program physicists and mathematicians often use the concept of 'n' dimensions. This idea is highly speculative compared to the proposed cosmic light speed rotation. **To unify 2 interactions if 5 dimensions are required, for unifying 4 interactions 10 dimensions are required. For 3+1 dimensions if there exists 4 (hitherto observed) interactions, for 10 dimensions there may exist 10 (observable) interactions. To unify 10 interactions 20 dimensions are required. It seems this is a mathematical problem rather than a serious fundamental physical problem**. Applying this idea to cosmology some people say- there exists other universes in n-dimensions. But what to do with these unknown and hiding dimensions and universes. In 3+1 if there exists space, ether, gravitational radiation, dark matter and dark energy etc in n- new dimensions there may exist a number of new and strange things. The surprising and compromising statement is that: n- new dimensions curl up in ordinary 3+1 dimensions. Even though it is very interesting, from fundamental physics point of view this 'n dimensions' concept is highly speculative. Till today no single new physical property was defined in 'n' extra dimensions.

In this sensitive and mysterious issue author's humble appeal is: **first let us find the primitive, natural and universal physical limits that may exist in the universal physics lab. With their implementation existing physical concepts and physical equations can be simplified and physical models can be refined.** c, $\hbar/2$, **force** c^4/G, **and power** c^5/G **are really the utmost fundamental tools of black hole physics and black hole cosmology**. To proceed further, it is a must to show that,

1. There is a fundamental flaw in the basics of modern flat cosmology. It goes back to 1929 Hubble's interpretation of galactic redshift data [3, 4]. It's correct interpretation is: 'rate of increase' in red shift is a measure of cosmic rate of expansion.

2. Rate of decrease in CMBR temperature is a measure of cosmic rate of expansion. 'Cosmic isotropy' and 'cosmic acceleration' both are inversely proportional to each other.

3. Dimensions of Hubble's constant are 'radian/sec' but not '1/sec'. This is very simple and brings cosmic rotation into picture.

4. Universe follows a closed expanding boundary. Best example is :'Apple grows like an apple' with closed expanding/growing boundary. Rotation will make the closed expanding universe stable.

5. At any time, strong gravity plays an interesting role in minimizing the (expanding) cosmic size.

6. Large cosmic time and smooth cosmic expansion play an interesting role in the evolution of fundamental particles.

10.1 Proposed five assumptions

Starting from the planck scale, it is assumed that, at any time (t),

1. The universe can be treated as a rotating and growing black hole.

2. With increasing mass and decreasing angular velocity, the universe is always rotating with speed of light.

3. Without 'cosmic rotation' there is no 'cosmic temperature'. Cosmic temperature follows Hawking black hole temperature formula where mass is equal to the geometric mean of planck mass and cosmic mass.

4. 'Rate of decrease' in CMBR temperature is a measure of cosmic 'rate of expansion'.

5. Space, time and matter are the immediate and parallel results of cosmic expansion.

10.2 The cosmic critical density and its dimensional analysis

Assume that, a planet of mass (M) and size (R) rotates with angular velocity (ω_e) and linear velocity (v_e) in such a way that, free or loosely bound particle of mass (m) lying on its equator gains a kinetic energy equal to potential energy as,

$$\frac{1}{2}mv_e^2 = \frac{GMm}{R} \tag{43}$$

$$R\omega_e = v_e = \sqrt{\frac{2GM}{R}} \quad \text{and} \quad \omega_e = \frac{v_e}{R} = \sqrt{\frac{2GM}{R^3}} \tag{44}$$

i.e Linear velocity of planet's rotation is equal to free particle's escape velocity. Without any external power or energy, test particle gains escape velocity by virtue of planet's rotation. Using this idea, 'Black hole radiation' and 'origin of cosmic rays' can be understood. Note that if Earth completes one rotation in one hour then free particles lying on the equator will get escape velocity. Now writing, $M = \frac{4\pi}{3}R^3\rho_e$,

$$\omega_e = \frac{v_e}{R} = \sqrt{\frac{8\pi G\rho_e}{3}} \quad \text{Or} \quad \omega_e^2 = \frac{8\pi G\rho_e}{3} \tag{45}$$

$$\text{Density, } \rho_e = \frac{3\omega_e^2}{8\pi G} \tag{46}$$

In real time, this obtained density may or may not be equal to the actual density. But the ratio, $\frac{8\pi G\rho_{real}}{3\omega_{real}^2}$ may have some physical meaning. The most important point to be noted here, is that, as far as dimensions and units are considered, from equation (46), it is very clear that, proportionality constant being $\frac{3}{8\pi G}$,

$$\text{density} \ \propto \ (\text{angular velocity})^2 \tag{47}$$

Equation (45) is similar to "flat model concept" of cosmic "critical density"

$$\rho_c = \frac{3H_0^2}{8\pi G} \tag{48}$$

Comparing equations (45) and (47) dimensionally and conceptually, $\rho_e = \frac{3\omega_e^2}{8\pi G}$ with $\rho_c = \frac{3H_0^2}{8\pi G}$

$$H_0^2 \rightarrow \omega_e^2 \ \ and \ \ H_0 \rightarrow \omega_e \tag{49}$$

In any physical system under study, for any one 'simple physical parameter' there will not be two different units and there will not be two different physical meanings. This is a simple clue and brings "cosmic rotation" into picture. This is possible in a closed universe only. It is very clear that, dimensions of 'Hubble's constant' must be 'radian/second'. Cosmic models that depends on this "critical density" must accept 'angular velocity of the universe' in the place of 'Hubble's constant'. In the sense, 'cosmic rotation' must be included in the existing models of cosmology. Then the term 'critical density' simply appears as the 'spherical geometric density' of the closed and expanding universe. One should not deny this dimensional analysis.

10.3 Planck scale and cosmic black hole temperature

At any time (t) from assumption (1) based on black hole concepts, if mass of the universe is (M_t) size of the cosmic black hole can be given by

$$R_t = \frac{2GM_t}{c^2} \tag{50}$$

From assumption (2) if the cosmic black hole rotates with light speed then cosmic angular velocity can be given by

$$\omega_t = \frac{c}{R_t} = \frac{c^3}{2GM_t} \tag{51}$$

From assumption (3) ,

$$T_t = \frac{\hbar c^3}{8\pi k_B G\sqrt{M_t M_P}} \tag{52}$$

where $M_t \geq M_P$. From equations (51) and (52)

$$4\pi k_B T_t = \hbar\sqrt{\omega_t \omega_P} \tag{53}$$

This is a very simple expression for the long lived large scale universe! At any time if temperature (T_t) is known

$$\omega_t = \left(\frac{4\pi k_B T_t}{\hbar}\right)^2 \left(\frac{1}{\omega_p}\right) \tag{54}$$

Substituting the present cosmic CMBR temperature [54] 2.726 °K in equation (54) we get present cosmic angular velocity, $\omega_t \cong 2.169\times10^{-18}$ rad/sec $\cong$ 66.93 Km/sec/MPc. Numerically this obtained value is very close to the measured value of Hubble's constant (H_0) . Not only that

this proposed unified method is qualitatively and quantitatively simple compared with the "cosmic red shift" and "galactic distance" observations. This procedure is error free and is reliable. **Author requests the science community to kindly look into this kind of rotating and growing universe models. If this procedure is really true and applicable to the expanding universe then accelerating model, dark matter and dark energy are becomes ad-hoc concepts**.

10.4 Cosmic mass density and baryon-photon number density ratio

With this model empirically it is noticed that, mass density

$$\rho_{mass} \cong 3\ln\left(\frac{R_t}{R_P}\right)\left[\frac{aT_t^4}{c^2}\right] \cong 6\ln\left(\frac{T_P}{T_t}\right)\left[\frac{aT_t^4}{c^2}\right] \quad (55)$$

If, $T_t = 2.726\,^{\circ}\mathrm{K}$, $\omega_t = 2.169\times10^{-18}\frac{\mathrm{rad}}{\mathrm{sec}}$, $R_t = \frac{c}{\omega_t} = 1.383\times10^{26}$ meter and $R_P = 3.232\times10^{-35}$ meter, present mass density is $\rho_{mass} \cong 418.82\times4.648\times10^{-34} = 1.95\times10^{-31}\frac{\mathrm{gram}}{\mathrm{cm}^3}$ This is very close to the observed mater density [56] of the universe $(1.75 \text{ to } 4.1)\times10^{-31}\frac{\mathrm{gram}}{\mathrm{cm}^3}$. If this idea is true the proposed term

$$3\ln\left(\frac{R_t}{R_P}\right) \cong 6\ln\left(\frac{T_P}{T_t}\right) \quad (56)$$

can be given a chance in modern cosmology. Actually this is the term given as

$$\ln\left(\frac{\text{cosmic volume at time, } t}{\text{planck volume}}\right) \cong 3\ln\left(\frac{R_t}{R_P}\right) \quad (57)$$

The interesting idea is that, if $R_t \to R_P$, and $T_t \to T_P$, the term $3\ln\left(\frac{R_t}{R_P}\right) \to 0$ and mass density at planck time approaches zero. Conceptually this supports the big bang assumption that"at the time of big bang matter was in the form of radiation". Not only that as cosmic time increases mass density gradually increases and thermal density gradually decreases. Using this term and considering the present CMBR temperature baryon-photon number density ratio can be fitted as follows.

$$\frac{N_B}{N_\gamma} \cong 3\ln\left(\frac{R_t}{R_P}\right)\left[\frac{2.7k_BT_t}{m_nc^2}\right] \quad (58)$$

Here interesting point is that

$$\left[\frac{2.7k_BT_t}{m_nc^2}\right] \cong \frac{\text{average energy per photon}}{\text{rest energy of nucleon}} \quad (59)$$

Present value can be given as

$$\frac{N_B}{N_\gamma} \cong \frac{1}{3.535\times10^9} \quad (60)$$

10.5 The 2 real densities

Since the cosmic black hole always follows closed model and rotates at light speed, at any time size of cosmic black hole is $\left(\frac{c}{\omega_t}\right)$. It's density $= \left(\frac{\text{mass}}{\text{volume}}\right) = \left(\frac{3\omega_t^2}{8\pi G}\right)$. It is no where connected with "critical density" concepts. It is noticed that

$$\frac{3\omega_t^2}{8\pi G} = 5760\pi\left[\frac{aT_t^4}{c^2}\right] \quad (61)$$

Finally we can have only 2 real densities, one is "thermal energy density" and the second one is "mass density".

10.6 Origin of the cosmic red shift, galaxy receding and galaxy revolution

As the cosmic sphere is expanding and rotating galaxies receding and revolving from and about the cosmic axis. As time passes photon from the galaxy travels opposite to the direction of expansion and reaches to the cosmic axis or center. Thus photon shows a red shift about the cosmic center. If this idea is true cosmic red shift is a measure of galactic distances from the cosmic axis of rotation or center. Galaxy receding is directly proportional to the rate of expansion of the rotating cosmic sphere as a whole. In this scenario for any galaxy continuous increase in red shift is a measure of rapid expansion and "practically constant red shift" is a measure of very slow expansion. That is change in galaxy distance from cosmic axis is practically zero. At any time (t) it can be defined as, cosmic red shift

$$z_t = \frac{\Delta\lambda}{\lambda_{measured}} \leq 1 \quad (62)$$

when z_t is very small this definition is close to the existing red shift definition

$$z = \frac{\Delta\lambda}{\lambda_{emitted}} \quad (63)$$

At present time relation between equations (62) and (63) can be given as

$$\frac{z}{z+1} \cong z_t \quad (64)$$

Equation (64) is true only when z is very small. Note that at Hubble's time the maximum red shift observed was, $z = 0.003$ which is small and value of H_0 was 530 Km/sec/Mpc. By Hubble's time equation (62) might have been defined in place of equation (63). But it not happened so! When rate of expansion is very slow, i.e. at present, based on $v = r\omega$ concepts

$$v_t \cong z_tc \quad (65)$$

gives revolving galaxies tangential velocity where increase in red shift is very small and practically remains constant and galaxy's distance from cosmic axis of rotation can be given as,

$$r_t \cong \frac{v_t}{\omega_t} \cong z_t \left(\frac{c}{\omega_t}\right) \tag{66}$$

Numerically this idea is similar to Hubble's law. This indicates that there is something odd in Hubble's interpretation of present cosmic red shifts and galaxy moments. By this time even though red shift is high if any galaxy shows a continuous increase in red shift then it can be interpreted that the galaxy is receding fast in the sense this light speed rotating cosmic sphere is expanding at a faster rate. Measured galactic red shift data indicates that, for any galaxy at present there is no continuous increase in their red shifts and are practically constants! This is a direct evidence for the slow rate of expansion of the present light speed rotating universe. When the universe was young i.e. in the past, Hubble's law was true in the sense "red shift was a measure of galaxy receding (if born)" and now also Hubble's law is true in the sense "red shift is a measure of galaxy revolution". As time is passing "galaxy receding" is gradually stopped and "galaxy revolution" is gradually accomplished. Galaxies lying on the equator will revolve with light speed and galaxies lying on the cosmic axis will have zero speed. Hence it is reasonable to put the red shift boundary as 0 to 1. Then their distances will be proportional to their red shifts from the cosmic axis of rotation. Since the total cosmic sphere is rotating and expanding, galaxies will have some receding. This receding is directly proportional to the rate of expansion of the rotating cosmic sphere as a whole. In this scenario, for any galaxy, from and about the cosmic center,

1. If rate of increase in red shift is increasing - it means universe is expanding with acceleration.
2. If rate of increase in red shift is decreasing - it means universe is expanding with deceleration.
3. If rate of increase in red shift is same- it means universe is expanding with uniform velocity.
4. If rate of increase in red shift is zero- it means universe is not expanding.

10.7 The present cosmic time

1. Time required to complete one radian is $\frac{1}{\omega_t}$ where ω_t is the angular velocity of the universe at time (t). At any time this is not the cosmic age. If at present, $(\omega_t \to H_0)$, it will not represent the present age of the universe.
2. Time required to complete one revolution is $\left(\frac{2\pi}{\omega_t}\right)$.
3. Time required to move from planck volume to existing volume = present cosmic age. How to estimate this time? Author suggests a heuristic procedure in the following way.

$$t \propto 3\ln\left(\frac{R_t}{R_P}\right) \tag{67}$$

$$t \propto \left[\frac{M_P c^2}{4\pi k_B T_t}\right] \tag{68}$$

$$t \propto \left[\frac{\hbar}{k_B T_t}\right] \tag{69}$$

Proportionality constant being unity with the above 3 assumptions "cosmic time" can be given as

$$t \cong 3\ln\left(\frac{R_t}{R_P}\right) * \left(\frac{8\pi}{\omega_t}\right) \cong 24\pi \ln\left(\frac{R_t}{R_P}\right) * \left(\frac{1}{\omega_t}\right) \tag{70}$$

At present, $t \cong 4.85 \times 10^{21}$ seconds. After simplification, obtained relation can be given as

$$t = \sqrt{\frac{36\pi}{90}} \times \ln\left(\frac{T_P}{T_t}\right) \sqrt{\frac{3c^2}{8\pi G a T_t^4}} \tag{71}$$

$$t = 1.121 \times \ln\left(\frac{T_P}{T_t}\right) \sqrt{\frac{3c^2}{8\pi G a T_t^4}} = 4.85 \times 10^{21} \text{ sec} \tag{72}$$

Here $(T_t \leq T_P)$, and interesting idea is that if $T_t \to T_P$, the term, $\ln\left(\frac{T_t}{T_P}\right) \to 0$. It indicates that, unlike the planck time, here in this model cosmic time starts from zero seconds. This idea is very similar to the birth of a living creature. How and why, the living creature has born? - this is a fundamental question to be investigated by the present and future mankind. In the similar way, how and why, the "planck particle" born? has to be investigated by the present and future cosmologists. Proposed time is 9400 times of $\frac{1}{H_0}$. With this large time "smooth cosmic expansion" can be possible. Inflation, magnetic monopoles problem and super novae dimming can be understood by a "larger cosmic time and smooth cosmic expansion". If $T_t \cong 2.73 \times 10^{11}$ ^{0}kelvin, t $\cong$ 0.31 sec, $R_t \cong$ 13833.6 m, $\omega_t \cong$ 21671 rad/sec, $M_t \cong 9.31 \times 10^{30}$ Kg. If $T_t \cong 2.73 \times 10^{10}$ ^{0}kelvin, t $\cong$ 32.55 sec, $R_t \cong 1.38 \times 10^6$ m, $\omega_t \cong$ 216.71 rad/sec, $M_t \cong 9.31 \times 10^{32}$ Kg. One second after the birth of planck particle, $R_t \cong 4.23 \times 10^4$ m. This is less than one light second, 3×10^8 m . From this data it can be suggested that, the cosmic expansion is smooth. Based on the increasing cosmic time, 'cosmic isotropy' and 'cosmic acceleration' both are inversely proportional

to each other. Inflation, magnetic monopoles problem and supernovae dimming etc can be understood by a 'larger cosmic time and smooth cosmic expansion'. It indicates that, unlike the planck time, here in this model cosmic time starts from zero seconds. This idea is very similar to the birth of a living creature. How and why, the living creature was born? - this is a fundamental question to be investigated by the present and future mankind. In the similar way, how and why, the 'planck particle' was born? has to be investigated by the present and future cosmologists.

To a great surprise, this obtained time is matching with 96.84% of the present age of lord Brahma of Hindu or Indian vedic cosmology = 158.7 trillion years = 5×10^{21} seconds [57]. Really this is a miracle. This may be a coincidence also. The interesting question is – why and how the ancient Indians obtained that number? If so the interesting thing is that 1.7 days of lord Brahma is roughly matching with the current estimations of cosmic age!

11 Conclusion

In cosmology, one should not forget the history of the unexpected discovery of the famous CMBR temperature and the famous Einstein's 'lambda' term. The subjects of cosmology and black hole physics are still very much open. Any thing may happen at any time. A debate is well going on the 'existence' and 'growth' of black holes' [6,45,58,59,60]. Proposed classical limits can be given a chance in fundamental and unified physics. Author showed the different applications of force c^4/G, and power c^5/G in astrophysics. With these 2 expressions or limits, mathematical complexity in GTR can be resolved. Not only that, force c^4/G, plays a crucial role in Grand unification and power c^5/G plays a crucial role in gravitational radiation. Even though detection of primordial cosmic black holes is very difficult, their direct effects are best seen in the form of old and new galaxies and their fast spinning galactic centers. Recent observations reveals that galactic central black holes are spinning close to speed of light. Another debate is well going on the 'cosmic acceleration, the existence of dark matter and dark energy' [49-53]. Compared to dark matter and dark energy, primordial cosmic black holes connects GTR, quantum mechanics and comology in a unified manner. Thinking positively, from its birth to its present state, universe can be considered as a growing and rotating primordial black hole. Constant 'light speed rotation' maintains its stability and rate of decrease in temperature indicates its growth or expansion rate.

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References

1. U.V.S. Seshavatharam. Physics of Rotating and Expanding Black Hole Universe. Progress in Physics, vol. 2, April, 2010, p. 7-14.

2. U. V. S. Seshavatharam and S. Lakshminarayana. Unified model of universe and the atom. Book. ISBN: 9783843393966, LAP LAMBERT Academic Publishing GmbH & Co. KG, Germany, 2011 March.

3. Hubble E. P. A relation between distance and radial velocity among extra-galactic nebulae. PNAS, 1929, v. 15, 168-173.

4. Hubble, E.P. The 200-inch telescope and some problems it may solve, PASP, 59,153-167, 1947.

5. Black Holes spinning near the Speed of Light. http://www.space.com/scienceastronomy080115-st-massive-black-hole.html

6. B. J. Carr. Primordial Black Holes: Do They Exist and Are They Useful? Proceedings of "Inflating Horizon of Particle Astrophysics and Cosmology", Universal Academy Press Inc and Yamada Science Foundation (2005).

7. Eun-Joo Ahn and Marco Cavaglia. Cosmic black holes, Int. J. Mod. Phys. D, Volume: 12, Issue: 9(2003) pp. 1699-1704.

8. Nikodem J. Popawski, Radial motion into an Einstein-Rosen bridge. Physics Letters B. Volume 687, Issues 2-3, 12 April 2010, p 110-113

9. Tianxi Zhang. A New Cosmological Model: Black Hole Universe. Volume 3, July 2009 Progress in Physics.

10. R. K. Pathria, The Universe as a Black Hole, Nature 240, 298-299 (1 December 1972).

11. Hawking S.W. Black Holes and Baby Universes and Other Essays, (Bantam Books 1993)

12. Thorne. Kip, Black Holes and Time Warps: Einstein's Outrageous Legacy, W. W. Norton & Company; Reprint edition, January 1, 1995.

13. Kurt Godel. Rotating Universes in General Relativity Theory. Proceedings of the international Congress of Mathematicians in Cambridge, 1: 175-81, 1950.

14. P Kanti. Black holes in theories with large extra dimensions: A review. Int. J. Mod. Phys. A 19 (2004) 4899.
http://arxiv.org/abs/hep-ph/0402168v2

15. Dmitri Rabounski. On the Speed of Rotation of Isotropic Space: Insight into the Redshift Problem. The Abraham Zelmanov Journal, Vol. 2, 2009, 208-223.

16. Dmitri Rabounski. Hubble Redshift due to the global non-holonomity of Space. The Abraham Zelmanov Jounal, Vol. 2, 2009, 11-28.

17. W. C. Daywitt. The Planck Vacuum. Progress in Physics, vol. 1, Jan, 2009, p.20-26.

18. Ludwik Kostro. Physical Interpretations Of The Coefficients c/G, c2/G, c3/G,c4/G, c5/G That Appear In The Equations Of General Relativity. Paper presented in Mathematics, Physics and Philosophy In the Interpretations of Relativity Theory. Budapest 4-6 September 2009.
http://www.phil-inst.hu/ szekely/.

19. N. Haramein et al. The Origin of Spin: A Consideration of torque and coriolis forces in Einstein's field equations and Grand unification theory. 153-168, 2005. The Noetic Press, Printed in the United States of America. http://theresonanceproject.org/.

20. E.A. Rauscher. A Unifying Theory of Fundamental Processes. Lawrence Berkeley National Laboratory Report. (UCRL-20808 June 1971) and Bull. Am. Phys. Soc. 13, 1643 (1968).

21. J.V. Narlikar. An Introduction to Cosmology. 3rd edition, Cambridge University Press.(2002)

22. U. V. S. Seshavatharam and S. Lakshminarayana, Super Symmetry in Strong and Weak interactions. Int. J. Mod. Phys. E, Vol.19, No.2, (2010), p.263.

23. U. V. S. Seshavatharam and S. Lakshminarayana, Role of Avogadro number in grand unification. Hadronic Journal. Vol-33, No 5, 2010 Oct. p513.

24. U. V. S. Seshavatharam and S. Lakshminarayana, Atomic gravitational constant and the origin of elementary magnetic moments.
Hadronic journal, Vol-33, 655- 680 (2010).

25. U. V. S. Seshavatharam and S. Lakshminarayana, SUSY and strong nuclear gravity in (120-160) GeV mass range. Hadronic journal, Vol-34, No 3, 2011 June, p277-300

26. Hawking S.W. A Brief History of Time. Bantam Dell Publishing Group. 1988.

27. Schwarzschild K. On the gravitational field of a mass point according to Einstein's theory. Sitz. der Koniglich Preuss. Akad. der Wiss, 1916, v. 1, 189-196.

28. Roger Penrose. Chandrasekhar, Black Holes, and Singularities. J. Astrophys. Astr. (1996) 17, 213231

29. Stephen Hawking, A Brief History of Time. Bantam Books. (1988)

30. P. M. Alsing et al. Simplified derivation of the Hawking-Unruh temperature for an accelerated observer in vacuum. American Journal of Physics 72 (12): 1524. (2004) . arXiv:quant-ph/0401170v2

31. Hawking S.W. Particle Creation by Black Holes. Commun. Math. Phys. 43, 199-220

32. Robert P. Kirsnner. Hubble's diagram and Cosmic expansion. PNAS, Jan-2004 vol.101, no. 1 page no: 8-13.

33. J. Huchara. Estimates of the Hubble Constant, 2009. Harvard-Smithsonian Center for Astrophysics. http://hubble.plot.dat

34. Dominic Brecher et al. Rotating Black Holes in a Godel Universe. hep-th/0309058 UUITP-15/03.

35. M.L. Fil chenkov et al. Quantum birth of the rotating universe. Gravitation & Cosmology, Vol. 11 (2005), No. 12 (41 42), pp. 116118 . Proceedings of the International Conference on Cosmoparticle Physics "cosmion-2004" 2005, Russian Gravitational Society.

36. Robert V Gentry. New Cosmic Center Universe Model Matches Eight of Big Bang's Major Predictions Without The F-L Paradigm. CERN preprint, EXT-2003-022, 14 Apr 2003. www.robertvgentry.com/reports/ext-2003-022.pdf.

37. G. Chapline et al. Tommy Gold Revisited: Why Does Not The Universe Rotate? http://www.arxiv.org/abs/astro-ph/0509230v2.

38. Mauro Dorato. On becoming cosmic time and rotating universes. Time, Reality and Experience (provisional title), Royal Institute of Philosophy Series, Cambridge University Press, 2001.

39. Frank Grave et al. Visiting the Gdel Universe. posted online 19 October 2008; mailed on 13 October 2008.

40. Istvan Nemeti et al. Visualizing ideas about Godel-type rotating universes. Godel-type Spacetimes: History and New Developments.

41. Yuri N. Obukhov. On physical foundations and observational effects of cosmic Rotation. Published in Colloquium on Cosmic Rotation, Eds M. Scherfner, T. Chrobok and M. Shefaat (Wissenschaft und Technik Verlag: Berlin, 2000) pp. 23-96. http://arxiv.org/abs/astro-ph/0008106v1,7August 2000.

42. Shi Chun et al, Is the universe rotating? http://arxiv.org/abs/0902.4575v3

43. G. Chapline. Blueprint for a Rotating Universe. http://arxiv.org/ftp/astro-ph/papers/0608/0608389.pdf

44. Carilli et al. Black Holes Lead Galaxy Growth, New Research Shows. Lecture presented to the American Astronomical Society's meeting in Long Beach, California. 4-8 January 2009. National Radio Astronomy observatory. Socorro, NM. www.nrao.edu/pr/2009/bhbulge.6 Jan 2009.

45. Kirpal Nandra et al, The Growth of Supermassive Black Holes Across Cosmic Time. http://astro.ic.ac.uk/content/growth-supermassive-black-holes-across-cosmic-time

46. John Kormendy et al. Supermassive black holes do not correlate with dark matter halos of galaxies. Nature Letter, 20 January 2011, http://arxiv.org/abs/1101.4650v1

47. Saul Perlmutter. Supernovae, Dark Energy and the Accelerating Universe. 2003 American Institute of Physics, S-0031-9228-0304-030-4, April 2003 Physics Today.

48. Joshua A. Fireman et al. Dark Energy and the Accelerating Universe. http://www.arxiv.org/abs/0803.0982v1

49. Mustapha Ishak. Remarks on the Formulation of the Cosmological Constant/Dark Energy Problems. Found Phys (2007) 37:14701498 .

50. J. W. Moffat. Modified Gravity Or Dark Matter? http://arxiv.org/abs/1101.1935v2

51. Narlikar, J. V et al. (2002). Interpretations of the Accelerating Universe. arXiv:astro-ph/0205064.

52. R. G. Vishwakarma et al. Modeling repulsive gravity with ceation. J. Astrophys. Astr. (2007) 28, 1727.

53. Arman Shafieloo et al. Is cosmic acceleration slowing down? Phys. Rev. D 80, 101301 (Rapid Communication). http://arxiv.org/abs/0903.5141v4. 8 Oct 2009.

54. W.-M. Yao et al. Cosmic Microwave back ground. April 2006. Journal of Physics, G33, 1, 2006.

55. Massimo Ricotti et al, Effect of primordial black holes on the cosmic microwave background and cosmological parameter estimates. The Astrophysical Journal, 680:829-845, 2008 June 20

56. Craig J. Copi et al. Big bang nucleosynthesis and the baryon density of the universe. Fermilab. astro-ph/9407006. Submitted to Science. http://arxiv.org/abs/astro-ph/9407006v2.

57. Ebenezer Burgess. 'Translation of the Surya-Siddhanta, a text-book of Hindu Astronomy', Journal of the American Oriental Society 6 (1860): 141- 498.

58. S. Chandrasekhar, Truth and Beauty: Aesthetics and Motivations in Science, University of Chicago Press, 1987, pages 153-154.

59. Stephen J. Crothers. The Black Hole Catastrophe And the Collapse of Spacetime, Conference On Precession & Ancient Knowledge, October 3-5, 2008, University of California, San Diego, USA.

60. Abhas Mitra. The fallacy of Oppenheimer Snyder Collapse: no general relativistic Collapse at all, no black hole, no physical singularity. http://arxiv.org/abs/1101.0601v1