International Journal of Trend in Research and Development, Volume 3(1), ISSN: 2394-9333
www.ijtrd.com

Certain Cosmological Implications of Vethathirian Axioms about Space

[1]Alagar Ramanujam and [2]Keith Fitzcharles
[1]Former Principal & Professor of Physics, N.G.M. College, Pollachi, India
[2]Vethathiri International Academy, Chennai

Abstract: In a recent paper (2014) we advanced a set of axioms called Vethathirian axioms about Space and from them a formula for mass was obtained in terms of its causative factors and from the mass formula, for the first time, Newton's law of gravity was derived without resorting to Kepler's laws of planetary motion or any thermo dynamical considerations. Extending this work further, we obtain in this paper two differential equations which resemble the famous Friedmann cosmological equations derived by him in 1922 by combining Einstein's gravitational field equations and Robertson-Walker metric. Our differential equations are solved here for r (the radius of the Universe). The solutions lead us to a modified Hubble's law. The inflationary mode of expansion of the early universe emerges from the solutions. We predict in this paper a far reaching result that after about 340 billion of years, the universe will stop expanding.

Keywords*: Vethathirian Axioms of Space, Cosmological Constant, Hubble's constant, Friedmann Equations, Inflationary Expansion, Accelerating Universe.*

I. INTRODUCTION

Every theory has a set of axioms to begin with. Axioms dealing with molecules led us to the kinetic theory of gases; axioms about light velocity gave us the special Theory of Relativity. Going subtler, we proposed in a recent paper (2014) two axioms called Vethathirian axioms about Space and using those axioms, we derived (2014) the law of gravity without using Kepler's laws of planetary motion or any thermo dynamical considerations(Padmanabhan.T 2010,Eric Verlinde 2010). Extending that work further we propose in this paper a cosmological model for the dynamics of the universe as a whole.

For the sake of ready reference and an easy understanding of the model given here, we give below axioms framed about Space (2014).

1. Space is all pervading and is endowed with potential Energy. It has the property of self- compression and exerting compressive pressure on every system or a group of systems in it.
2. Self- compression results in the formation of spinning quanta of Space, called "formative dust". Due to the spin, every dust or a group of dust becomes a source of a spherical spreading wave-front in Space.

In the reference (2014), using the above axioms we derived Newton's law of gravity,

$$F = G.M.m / x^2$$

for two bodies of masses M and m kept at a distance of x from each other without using Kepler's laws of planetary motion. Here, F stands for the compressive force given by Space on the masses M and m tending to move them towards each other.

The above derivation is historical in the sense that the gravity formula of Newton remains till today as a result deduced by him from Kepler's Law, but not derived by him from basic axioms. Newton, in fact refused to frame axioms about gravity. Our work in the reference (2014) supplies the long pending derivation. In the reference (2014), our derivation of the formula for the Gravitational Force gives a greater insight into the constant G. In Newtonian deduction of the gravity formula, G appears as a proportionality constant; but in our derivation, G is obtained as a product of two constants β and **μ**. β has a dimension of $L^{-3}\,T^2$ *and* μ *has a dimension of* M^{-1}.

Hence, $G\left(\frac{\mu}{4\pi\beta}\right)$ *has a dimension* of $M^{-1}\,L^3\,T^{-2}$.

II. THE EXPANDING UNIVERSE

Let r be the present radius of the universe. At every moment massive fundamental particles are being formed by and of Space. So, in order to accommodate them the boundary of the universe increases. At the same time, the massive particles formed billions and billions of years ago, after losing their mechanical spin, become Space again. This process makes the boundary to shrink. So r will be a function of time, with the following three possibilities:

The radius r may increase with time, making our universe an expanding one or r may decrease with time, making our universe a contracting one or the production and annihilation of the massive particles adjusting themselves in such a way that r remains stationary, leading to a kind of static universe.

The experimental observations of Hubble (1929) indicate the first possibility as the present phase of the universe.

Consider an object (P) of unit mass and of unit area on the surface of the expanding universe which is considered here as a spherical distribution of cosmic fluid of material particles. The compressive force on the unit mass due to Space is given as,

$$\mathbf{F} = \frac{GM}{r^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(1)}$$

where, M is the mass of the universe and r is its radius.

The material particles which are in a state of mutual repulsion due their spin and hence in random motion collide on the boundary of the universe giving rise to an outward pressure on the boundary. This outward pressure opposes the compressive pressure due to Space. In molecular physics we have a well known formula for the pressure of the Gas as,

$$\mathbf{p} = \frac{1}{3}\rho v_m^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(2)}$$

where, ρ is the density of the gas and v_m^2 is the mean square velocity of the gas molecules. Promoting this equation to the cosmic fluid of independent free particles filling up the universe, we write for the outward pressure on the object (P) on the surface of the universe as

$$\mathbf{P} = \frac{1}{3}\rho c^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(3)}$$

where, ρ is the density of the universe. We take here the velocity of the particles as near c. The current expansion phase of the universe has been confirmed by Hubble's experiment, and this confirmation indicates that the outward pressure on P is greater than compressive force. Hence we write,

$$\ddot{r} = \frac{1}{3}\rho c^2 - \frac{GM}{r^2}$$

$$\ddot{r} = \left(\frac{c^2\rho}{3} - \frac{4\pi G r\rho}{3}\right) \ldots\ldots\ldots\ldots\ldots\ldots \text{(4)}$$

where $\ddot{r}$ is the force on the object P situated at the rim of the universe, pushing it away from the observer.

It may be noted here that in eqn.(4) ρ in the first term exhibits its inertial aspect and ρ in the second term exhibits its gravitational aspect. It is remarkable that the interplay between the inertial aspect of matter and the gravitational aspect of Space combined together determine the nature of expansion of the universe.

Significantly, **e**qn.(4) resembles the second of the two cosmological equations derived by Friedmann(1922) using Einstein's field equations along with Robertson-walker metric. We give below the two equations of Friedmann for the sake of ready reference.

$$H^2 = \left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3}\rho - \frac{KC^2}{a^2} + \frac{\Lambda}{3} \quad \ldots\ldots\ldots\ldots \text{(5)}$$

$$\frac{\ddot{a}}{a} = -\frac{4\pi G}{3}\rho^* + \frac{\Lambda}{3} \ldots\ldots\ldots\ldots \text{(6)}$$

Where $\rho^* = (\rho + 3p/c^2)$

Where a, is the normalized radius of the universe, p is the pressure due to the cosmic fluid filling up the universe, Λ is the cosmological constant and H is the Hubble Constant.

Focusing on the energy considerations of the unit mass (P), we have,

$$F.dr = d\,(K.E)$$

$$\left(\frac{1}{3}\rho c^2 - \frac{GM}{r^2}\right) dr = d\left(\frac{1}{2}v^2\right) \text{ for } r < r_E$$

$$\frac{1}{3}\rho c^2\dot{r} - \frac{GM}{r^2}\dot{r} = v\dot{v}$$

$$\frac{1}{3}\rho c^2\dot{r} - \frac{4\pi G\rho}{3}r\dot{r} = v\dot{v} \ldots\ldots\ldots\ldots \text{(7)}$$

If we use Hubble's relation, v = Hr, the above relation will reduce to,

$$H^2 = \frac{\rho C^2}{3r} - \frac{4\pi G\rho}{3},$$

which resembles to the first of the equations of Friedmann**.**

Our equation (4) has an advantage over Friedmann equation in the sense that the role of the adhoc cosmological constant introduced by Einstein with no real physical source assigned to it till date, is being played in our equation by the term ρ which stands for the density of the universe.

We shall now see a consequence of the equn. (4).

$$\ddot{r} = \frac{1}{3}\rho c^2 - \frac{4\pi G\rho}{3}r$$

$\ddot{r}$ will become zero when $c^2 = 4\pi G r$ or

When r = $\frac{C^2}{4\pi G} = \frac{8.94\times10^{16}}{4\pi\times6.7\times10^{-11}} = r_E = 1.11\times10^{26}m$ = 3598 Mpc.

Since c and G are Universal constants, r_E is also a universal constant characteristic of our universe.

At r = r_E, the net force on the unit mass becomes zero and the universe will still expand with the velocity (v_E) acquired by the unit mass at r = r_E. This expansion will be opposed by the restoring force that comes into play when r $> r_E$. The radius r will keep increasing beyond r_E until $\dot{r}$= 0. When $\dot{r}$= 0, let us call r = r_μ. At r = r_μ, the restoring force will start contracting the universe.

So long as r remains $< r_E$ the universe will expand with acceleration and hence the velocity of the expansion will increase with r. It is highly remarkable that Hubble confirmed this result by his experiments.

Let us solve our cosmological equation (4) to find as expression for r.

$$\ddot{r} = \frac{1}{3}\rho c^2 - \frac{4\pi G\rho r}{3}$$

$$\frac{d^2 r}{dt^2} + \left(\frac{4\pi G\rho}{3}\right) r = \frac{1}{3}\rho c^2$$

where $a^2 = \frac{4\pi G\rho}{3}$; b = $\frac{1}{3}$ ρc^2 ;with ρ=3.00x10^{-28}kg/m^3

Solving the above equation and using the boundary condition; at t = 0, r is minimum (R), we have

$$\mathbf{r} = r_{E}\{1-\cos at\}+R \text{ .... } \mathbf{(8)}$$

III. MAXIMUM VELOCITY OF EXPANSION

Differentiating equation (8) and rearranging we have,

$$\dot{r} = \mathrm{v} = v_E\ \{1 - (1-q)^2\}^{1/2} \text{ ... ... } (\mathbf{9})$$

where, $q = \frac{r}{r_E}$ *and* v_E(=ar_E) is the maximum velocity of expansion.

Eqn.(9) gives the expansion velocity of the universe as a function of r. The velocity-distance formula given in eqn.(9) vastly differs from Hubble's law, v=Hr. The maximum velocity takes place at r = r $_E$ and is about 0.322 x 10^8 m/s

Differentiating eqn.(9) with respect to r we get,

$$\mathrm{dv/dr} = \frac{(1-q)}{r_E\ \{1-(1-q)^2\}^{1/2}} \text{ .... } \mathbf{(10)}$$

Eqn.(10) gives the variation of the expansion velocity over r, as a function of r. The equation indicates that the early universe of very low radius had a tremendous rate of expansion over r and that rate is steadily decreasing as r increases. It is significant that the inflationary mode of expansion of the early universe (Guth and Alan, 1997) emerges from our theory presented here.

DISCUSSION AND CONCLUSION

Thus, the Vethathirian axioms about Space lead us to a cosmological model which we call Vethathirian Model of the Universe. This model suggests the following scenario.

The universe oscillates between r=R and r=2r$_E$.At present the universe is in the expanding phase at an accelerated rate. This accelerating expansion will go on until the radius of the universe reaches a value of about,

r_E = (c^2/ $4\pi G$) = 1.11× 10^{26} m. At r = r_E, the outward driving force causing the universe to expand becomes zero. When the radius of the universe reaches r_E, the time t $(= \pi/2a)$ will be about 171.85 billion years. At r = r_E , the velocity of expansion of the universe will be $\left[(c^2 / \sqrt{(\frac{4}{3})\pi G\rho}\right]$ and of value 0.322× 10^8 m/sec.

Thereafter, the universe will still expand beyond r_E but with a deceleration caused by the opposing force. The expansion velocity will then not obey Hubble's law but will go on decreasing as r increases until it reaches zero when t will be about 343.7 billion years.

Once the velocity becomes zero, the restoring force will start reducing the radius back to r = r_E in a further time of 171.85 billion years and finally in a further time of about 171.85 billion years the radius would tend to R again. Thus our universe has a cyclic motion, oscillating between an r_{min} and r_{max} with a period of oscillation of about 687.4 billion years.

In Big Bang Model (BBM) *(*Lemaitre, G (1931*)* of the universe the one-time creation of space-time and matter at the time of big bang violates the law of conservation of energy. In BBM, nothing is said about conditions outside the "primordial egg" which underwent the big bang. While the BBM talks about the creation of matter, it does not say anything about annihilation of matter. But in the Vethathirian Model presented here, there was no big bang of any sort. The potential energy of Space gets transformed into particles with mechanical spin and thus the energy-matter conservation is maintained. The Vethathirian Model talks also about the annihilation of matter back into Space. Thus the law of conservation of energy is maintained both during production and annihilation process.

In the Steady State Theory (SST) matter is considered to be created continuously from a scalar field which has been purposely introduced in the theory to be a source of creation (Narlikar,1993). The adhoc scalar field introduced in SST is only a mathematical game devoid of any physical identity or reality. Thus almost all the models advanced so far talk of creation either as one-time event or as continuous process and they do not talk about any kind of annihilation process.

In sharp contrast to this, the Vethathirian Model does not talk about any kind of creation but considers matter to be spinning quanta of Space. Thus matter is a transformation of Space from potential to dynamic state. The Vethathirian Model considers a massive particle as nothing but a group of spinning quanta of Space. The quanta become Space again when they lose their spin.

A word of caution. Taking t=0 when r=R is only arbitrary and we do not know how many cycles the universe would have completed before coming to the position, r=R referred to in this paper as t=0.

Acknowledgment

The authors place their deepest reverence to Shri. Vethathiri Maharishi for having taught us his philosophy of Space in all details and in all depth.

They remain highly grateful to Mrs. and Mr.Raj Taneja of Chicago, Mrs. and Mr. Vijay Arora, New Jersey, Mrs.A.Thayar, Pollachi, Mrs. and Mr.Vikram Kannan, New Jersey and Mrs. and Mr.Babu Prasath of Pollachi for their constant interest in this work. Discussions with Mr.S.Muralidharan B.Tech, Sastra University, Kumbakonam (Tamil Nadu) is gratefully acknowledged.

References

[1] Alagar Ramanujam.G and Keith Fitzcharles Int. J. Trends in Phys. sci. Volume 3 (2014)

[2] Alagar Ramanujam.G, Keith Fitzcharles and K.Vinod Kumar Sci. Trans. Environ. Technov. Volume 2,167 (2009)

[3] Eric Verlinde (2010): AR XIV EPrint: 1001.0785

[4] Friedmann (1922), Z. Phys. Volume 10,377

[5] Guth, Alan.H (1997. The Inflationary Universe: Basic Books, 233

[6] Hubble, Edwin (1929): PNAS 15, 168

[7] Lemaitre, G. (1931). "The Evolution of the Universe: Discussion". *Nature*, *Volume* **128,** 699

[8] Narlikar, J. V. (1993). The Astrophysical Journal , Volume 410: 437

[9] Padmanabhan.T (2010), Reports in Progress of Physics. Volume 73

[10] Ranku Kalita, Journal of Modern Physics,(2015),Volume 6,1007