Synchronized-motion of Galaxy-clusters – a Pulsating model of Universe

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Abstract:

The galaxy-clusters move outwards in a synchronous manner, their speeds increasing at the expense of their internal energies; the process is self-limiting and reversible, and this puts the universe in an infinite-loop of pulsations. The model is based on the hypothesis that motion at speed 'c' is the fundamental property of matter, and hence the clusters can move at very high speeds. The model is complete in all respects, is in agreement with observational evidences, does not require any dark matter or dark energy, and predicts the Earth-moon distance correctly. Based on these, I claim that the proposed model is better than the existing ΛCDM model.

Key words: Infinite-loop, Cold state, CMBR, G of the universe, Space-constant, Filaments and voids, Event horizon, Entropy, Stars and black holes, Heat engines, Origin of life, Evolution of life, Earth- Moon distance

1. Introduction:

The structures of orbiting systems like planetary systems, galaxies and galaxy clusters are known to us. But the structures beyond that are not directly observable, and so we have to depend on theoretical models. The ΛCDM model, based on General Relativity, is regarded as the 'standard model of cosmology'. However, the model requires two mysterious entities, 'dark energy' and 'dark matter', and so is incomplete as at present.

In this paper, a new model of the universe, complete in all respects, is proposed. The new model is based on the hypothesis[1] that " *the fundamental particle of matter moves at speed 'c', and force is reaction to this motion*". If the hypothesis is correct, the natural energy of a galaxy-cluster will be $Mc^2/2$, and it will be moving at a speed close to one-third of the speed of light, the rest of the energy remaining inside. If we visualize that internal energy can change into speed and back, a simple mathematical model – a pulsating system in which 'c' decides the limit – can be formulated.

The proposed hypothesis makes both energy and force finite, and thus removes all the infinities present in the present theories. Any process will end in finite time; but the process can repeat again and again, thus creating an infinite-loop[2]. Force is finite implies that force can be partly or fully used, and force is reaction to motion implies that G depends on speed. As the universe is made up of matter only, the physical constants [3] of the proposed fundamental particle decide the parameters of the universe.

2. Motion of Galaxy-clusters:

It is proposed that galaxy-clusters are the individual units of the universe. The energy of a cluster remains divided as speed and internal energy. But, a static equilibrium cannot exist between these two; internal energy and speed remain changing. As the clusters are held together by gravity, an arbitrary change cannot happen to any particular cluster; the clusters act in a synchronous manner. When internal energy changes into speed, the clusters move outwards along helical paths, and the system expands. When internal energy can no more decrease, the expansion comes to an end, and the process reverses: speed changes into internal energy taking the system to the other extreme. This sets the system in an infinite-loop of pulsations. Thus the system formed by clusters is a pulsating system; and gravity makes the system perfectly spherical on a large scale.

When a cluster is closest to the centre, its motion is planar, in the plane perpendicular to the radius of the universe. As it moves outwards, the speed increases and the motion becomes helical. The outward component of the speed increases at a faster rate, and when expansion reaches halfway, both the components become equal. Thereafter, the outward component decreases and eventually reaches zero; the motion becomes planar and the expansion stops. The planar component reaches the maximum at that time.

Motion affects the following variables of the clusters: internal energy, speed, distance between clusters, gravity used and G[4]. The change in internal energy leads to two potential states, a state of high internal energy and state of low internal energy. If the former is identified as a hot state, the latter can be identified as cold[5] state. Thus motion affects the temperature also.

The existing pulsating models visualize an explosion like situation where bodies move outwards defying gravity; eventually gravity stops them and brings them back. In such models, the speed is zero at the limiting points, and gravity has a major role. However, in the new model proposed, the clusters remains in perpetual motion, and it is motion that causes pulsation; gravity has no major role.

3. Structure of the universe:

(i). A closed system:

The universe is a many-body system made up of galaxy-clusters. The basic units of the clusters are *masses*[7], many-body systems (like sun, moon, earth, etc) made up of atoms. Matter exists mainly as *masses*; a small amount of matter exists as a system of e-m radiations and it is observed as Cosmic Background Radiation[3], and another small amount remains as stray rocks, dust and particles. Other than these, there is nothing else in the universe, no virtual particles, antimatter, dark matter or dark energy.

The total energy (motion) inside the universe is $Mc^2/2$. The energy remains mainly with the clusters, as speed and internal energy. The total force (reaction to motion) in the universe is also $Mc^2/2$. The force remains mainly with the *masses*. Part of this is used for interaction between *masses* and the rest for interactions inside *masses*. Force thus remains completely used inside the universe that the universe as a whole has no field and cannot interact with other universes (if any). The universe is thus a closed[4] system.

Centre-filled systems like protons[6] and orbiting systems like galaxies[7] are open systems. The universe being a closed system, the centre is empty, and no bodies orbit around the centre. The clusters form a closed gravitational-chain[7] which branches into the galaxies, then to the *masses*, and ultimately to each atom. Thus any change that happens to the clusters is transferred down to the level of atoms through the chain. The boundary of the universe is a Gauzzian spherical surface beyond which no fields exist.

(ii). Dynamic equilibrium:

The clusters are confined together by gravity, and motion prevents these from collapsing into a single *mass*. However, a static equilibrium is impossible with just two forces; the speed, G, distance between clusters and gravity used remain varying. However, at any given time, the distance is such that the force used (calculated using the then G) is equal to the force available for interaction. If the force used increases, there is a corresponding decrease in the force used inside *masses*, and the atoms in the *mass* rearrange in such a way that attractive and repulsive forces again remain balanced inside it. The universe is thus in a state of dynamic equilibrium, and any change that happens to it is reversible.

(iv). Distribution of energy and distribution of elements:

The natural energy of a cluster is $Mc^2/2$. However, when the clusters form a system, there is energy transfer between them; the innermost clusters have the least energy and outer most clusters have the highest energy. The energy possessed is proportional to the distance from the centre. The cluster having exact natural energy remains at the exact centre between the boundary and centre of the universe. The elements present in the clusters also show such a gradation. The inner clusters have mainly light elements and the outer clusters have mainly dense elements; the middle clusters have nearly all the elements possible. As life cannot exist in extreme conditions, we can conclude that our galaxy belongs to a middle region cluster.

(vi). G of the universe:

The G of a *mass*/cluster is directly proportional to its speed. The G for unit speed[8] is 7.7937×10^{-20} for the *mass*/cluster having natural energy. A cluster having excess energy has a lower G for unit speed and a cluster having shortage of energy has a higher G for unit speed. The distribution of energy is such that at any given time, all clusters have the same G, though their speeds are different. We can call this the *G of the universe*, and it is equal to the G of the exact middle cluster having the exact natural energy.

Each galaxy in a cluster has a relative G that depends on its speed. This G decides the speed required by a *mass* to remain orbiting the galactic centre at a given distance. The distance, however, depends on the G of the universe. Thus both the constants have relevance. Similarly each *mass* has a relative G valid for the interactions in that *mass*. An increase in G means more force is required for a given distance.

(vii). Space-constant:

As gravity remains completely used and G of the universe is common, there exists a mass- distance relation for orbiting systems of *masses*; it can be given as, d = Ms, where 's' is the space-constant. This implies that mass 'M' remains enclosed in a spherical region of diameter 'Ms'. So the radius of any orbiting system, including galaxy-clusters, is Ms/2. During expansion, the space-constant increases, and so all orbiting systems expand.

(x). Packing of clusters – Filaments and Voids:

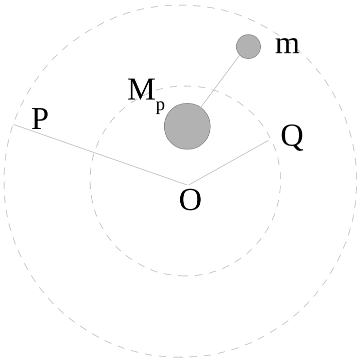
The clusters are closely packed, each cluster occupying a spherical region of diameter 'Ms', and their boundaries just touching (not overlapping), thus creating voids in between clusters. If the clusters were of the same size, a cluster would be touching all immediate neighbors; and the distance between clusters and the size of the voids would be uniform.

But in reality, the clusters are of different sizes, and so a cluster does not touch all the immediate neighbours, and the voids are of different sizes. So the structures at that level will appear to be 'filaments and voids' when viewed from inside.

(xi). Distance of orbiting members:

In a system containing a large number of orbiting members, the *parent mass*, if any, remains at the centre of the system. If M is the mass of the system and M_p, the mass of the *parent mass*, then M_p will be greater than M/2. So the average distance of orbiting members from the centre is $M_p s/2$, if there is a *parent mass,* and Ms/4, if there is no *parent mass*. In a system containing only one orbiting member, the *parent mass* remains displaced from the centre (Refer Fig-1), the distance increasing with the mass of the orbiting body. Here, the epicentre rotates around the centre of the system, and the average distance between the *parent mass* and the orbiting body is $M_p s/2$.

Fig-1: Distance of bodies in a two-body orbiting system:



'O' is the centre of the system. OP = Ms/2; OQ = Ms/4 If it is taken as a binary system, the average distance from centre 'O' is Ms/4. If the large body is taken as parent *mass*, the distance of the orbiting body is $M_p s/2$ from the parent mass.

(xii).Uniformity :

The space-constant is a mass- distance (not mass- volume) relation. So density will be more if matter is distributed as smaller *masses*. But, below a certain size, 'Ms' will be less than the diameter of the body, such bodies can be regarded as just rocks and not *masses*. Similarly, the interior density puts an upper limit to the size of a *mass*. The average size of a *mass* in the universe will be exactly in between these two limits. So the following pattern is proposed in the distribution of *masses* in the universe.

There are only four levels in the hierarchy of *masses*: satellites, planets, *masses* orbiting the galactic centres, and *masses* at the galactic centres. The clusters have no central *masses* and galaxies invariably have central *masses.* The number of orbiting members in a galaxy is very large compared to the number of galaxies in a cluster or the number of planets in a planetary system. The total mass of the orbiting members in a galaxy is somewhat close to that of its central *mass*. The universe thus remains nearly uniform.

4. Available Energy and Force:

The proposed fundamental particles integrate into electron-positron pairs[9], and these in turn integrate into neutrons[9]. Neutrons change into hydrogen atoms which integrate into *masses*. The energy and force of a *mass* are equal to $Mc^2/2$. Half of the energy remains inside the electron-positron pairs. Only a negligible amount is used for the formation of atoms, and so the energy available after the formation of atoms is nearly $Mc^2/4$. When electron-positron pairs are formed, the force gets divided equally[9] as gravity and electromagnetic force. So total gravity of a *mass* is $Mc^2/4$. Nearly 99.9% of this is used inside nucleus[8], and out of the rest, nearly one-fifth is used inside atoms. So, gravity available after the formation of atoms is $8.7556/10^4$ of total gravity[8].

Based on symmetry and balance, it is proposed that in an *ideal mass*[8] (a *mass* of hydrogen having normal energy), the above available energy remains divided in the ratio 25:75, as speed and internal-energy, and the available gravity remains divided in the ratio 50:50 for internal and external interactions[8]. When such *ideal masses* integrate into galaxy-clusters and the universe, there is energy transfer between *masses* and also between clusters; force, however, remains with the *masses*. Consequently, the above energy and force ratios get altered, and this results in the formation of other elements. So there is no *ideal mass* in the real universe.

The available energy of each cluster remains as its speed and internal energy. When the clusters move outwards, their internal energies decrease and speeds increase. Consequent on this, G of the universe increases and gravity used for interaction between *masse*s increases, and there is a corresponding decrease in gravity used inside *masse*s. Though an *ideal mass* does not exist in the universe, the way it would behave if it were part of the universe, can be logically interpreted and this can be used for obtaining the probable way in which the energy and force ratios change during the pulsation of the universe.

5. Hot and cold potential states:

Hot and cold states[5] are potential states of *masses*; single atoms do not have such states. An *ideal mass* having a speed- internal energy ratio 25:75 remains at absolute zero. Here, the hydrogen atoms are so packed that the internal energy of the *mass* manifests as lattice vibrations; half of the available gravity is used for the packing, and the forces (including energy which acts as repulsive force) remain balanced. If the speed- internal energy ratio of the *ideal mass* is changed, the atoms can no more remain at the respective positions in the lattice, instead these have to oscillate between positions, if forces are to remain balanced. This oscillations can be identified as heat/cold energy.

If speed of an *ideal mass* is increased at the expense of internal energy, it contracts, gets heated, and reaches the critical temperature and fusion reaction is kindled. The fusion reactions end up with iron. A further increase in speed does not cause contraction, and the mass starts cooling, ultimately reaching a very cold dense state. On decreasing the speed, the process reverses – assuming that released radiations remain with the *mass*.

If the above *mass* has shortage of energy, the fusion reaction end up before reaching iron, and if energy is below a certain level, fusion reactions are not kindled at all. If it has excess energy, fusion reactions go beyond iron; and above a certain level, very dense elements are created and the process becomes irreversible. The higher the energy, the higher is the intensity of the potential state. A *mass* of very dense elements require very high energy and these can reach very high potential states, both heat and cold.

Temperature indicates the intensity of hotness; so cold bodies have negative temperatures. The temperature- wavelength relation for cold bodies is $\lambda = b_cT$, where b_c the constant[3] for cold bodies is 9.12×10^{-3}m/K. The wavelength corresponding to 0K is

$5.141x10^{-3}$ m[3]. The highest and lowest temperatures[3] possible are $4.8433x10^{7}$ K above and below absolute zero. Black holes[5] are cold *masses* having very low temperatures.

For a given speed- internal energy ratio, *masses* in the universe remain at different temperatures. When heat energy (of *masses)* is more, the universe is in a hot state. When heat and cold energies are equal, the universe is at absolute zero. When cold energy is more, the universe is in a cold state.

6. The pulsating model:

The pulsation is due to the synchronized motion of clusters, and it resembles the expansion and contraction of a sphere which is always uniform. This provides a simple mathematical model. The changes in the variables like energy, force, distance, gravitational constant, temperature, etc. can be clearly mapped on this model. When the physical constants derived from the properties of the fundamental particle are incorporated in it, the model becomes complete in all respects.

(i). Speed- distance relation:

If the expanding sphere is to remain uniform, the speed of any point in it should be directly proportional to distance from the centre. So the speed of a cluster is directly proportional to the distance from the centre. The distance at which the speed becomes 'c' is the *event horizon* of the universe. At the end of expansion, the boundary of the universe reaches the event horizon. So the system of radiations extends to the boundary, whereas the galaxy-clusters remain well below that. Bodies should move faster than light to cross the event horizon; as this is impossible, nothing can escape from the universe.

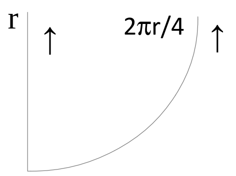
(ii). Period of pulsation:

The fundamental particle takes 62.56 billion years to complete one revolution[3]. So it would be logical to assume that the universe also takes that much time for pulsation. Light[3] being composed of particle-pairs takes only one-fourth of that time for one revolution. That is, in 15.64 billion years, expansion reaches half way and light completes one revolution.

(iii). Speed of expansion :

When internal-energy changes into speed, the clusters move outwards along helical paths. The outward component, which represents the speed of expansion, increases at a faster rate, reaches the maximum when expansion is halfway, and then decreases and reaches zero. So there is accelerating expansion till halfway, and so the speed- time graph of expansion is elliptical, and can be given by the relation, $v^2/A^2 + t^2/B^2 = 1$, where 'v' is the speed of expansion at time 't' measured from the halfway of expansion, A, the maximum speed of expansion, and B, the time required to reach that speed.

Fig-2. Radius- boundary relation of expanding universe:



When radius increases at speed 'v', the arc increases at speed $2\pi v/4$. The speed limit for arc is 'c'. So the limit of $v = 2c/\pi$.

When speed of expansion is the maximum, we can take that the points on the boundary moves at speed 'c', the limit. So the maximum speed of expansion, A = 2c/π (refer fig-2) and B =15.64 billion years. Thus the constants in the equation are known, and so the speed, acceleration and increase in radius at any instant can be calculated. The increase in radius during expansion is the distance traveled by the border; the graph being elliptical, the distance traveled = πAB/2 = π (2c/π) (15.64)/2 = 15.64 billion light years.

(iii). Average temperature of the universe :

Just before expansion, the internal energy of the clusters is the maximum, and consequently, all *masses* have high internal energy. So the *masses* are hot, that is, part of internal energy remains as potential heat energy. The temperature of the *masses* ranges from 0K to the upper limit. At the end of expansion, all *masses* are cold, the temperature ranging from 0K to the lower limit. The average temperature at the beginning and end corresponds to the geometric[3] mean of the wavelengths of 0K and the respective limits (refer table-1). At halfway of expansion, heat and cold energies are equal, and the average temperature is 0K.

Average temperature of universe during expansion			Temperature limits	
Beginning	Halfway	End	upper	lower
5225K	0K	-5225K	4.8433×10^{7}K	-4.8433×10^{7}K
5.5463×10^{-7}m	5.141×10^{-3}m	4.7653x10m	5.9835×10^{-11}m	4.4171×10^{5}m

Table-1: Temperature and corresponding wavelengths

The universe thus cools by 5225 degrees in 15.64 billion years. So the rate of cooling is one degree Kelvin in 2.99 million years.

(xi). Changes in Cosmic Background Radiation:

The CBR[3] is a system of radiations and is isotropic. As universe expands, the radiations cool by splitting into smaller quanta. The rate of cooling is the same as that of the universe, and so the wavelength corresponds to the average temperature of the universe (refer table-1). The later radiations emitted by *masses* appear as anisotropies in the CBR, and by the time expansion comes to an end, these merge completely in the background, and the anisotropies disappear. During contraction, the process reverses.

(xi). Changes in energy ratio:

The available energy of a galaxy-cluster ($Mc^2/4$ for the exact middle cluster – refer para.4) remains divided as external energy (speed) and internal energy. Part of the internal energy remains as potential energy (heat/cold) of the *masses*; the rest can be identified as 'internal kinetic energy'. During expansion, internal energy changes into speed. At any given time, the ratio of 'external energy', 'internal kinetic energy' and 'potential energy' is the same for all clusters. How the ratio changes during expansion can be interpreted based on symmetry and the expected behaviour of an *ideal mass*.

At halfway, the speed of expansion is 2c/π. That is the boundary moves outwards at that speed. As the planar and outward components are equal at halfway, the speed at the boundary is 2√2c/π. At the end of expansion, boundary reaches the event horizon and so the speed at boundary is 'c'. As speed is directly proportional to the distance from the centre, the speed of the exact middle cluster will be $\sqrt{2}c/\pi$ at halfway and c/2 at the end of expansion. As the available energy of the middle cluster is $Mc^2/4$, its external energy is 50% of the available energy at the end and 40.53%, at halfway of expansion. This is applicable to all clusters.

If an *ideal mass* were part of the universe, its external- internal energy ratio at the end of expansion would be 50:50, the natural ratio being 25:75. That is, at the end of expansion, internal energy is two-third of its normal internal energy. So at the beginning of expansion, its external energy would be two-third of the normal, that is, 16.67%. We can assume that the clusters follow the same pattern.

Thus the ratio of internal and external energies at the beginning, halfway and end of expansion are known. Symmetry implies that internal kinetic energy in the beginning should be equal to external energy at the end; and at halfway the two should be equal. From these, the ratio in which internal energy is split up into potential and kinetic parts at the beginning, halfway and end of expansion can be obtained (refer table-2).

	0	1	2	3	4
External energy	16.67	32.20	40.53	45.27	50.00
IE kinetic	50.00	45.27	40.53	32.20	16.67
IE potential	33.33	22.53	18.94	22.53	33.33

Table-2: Change in speed- internal energy ratio of clusters - '0' represents beginning and '4', end of expansion

As the percentage of potential energy at three points (0, 2 and 4) are known, the potential energy at any given time can be calculated graphically (refer fig-3).

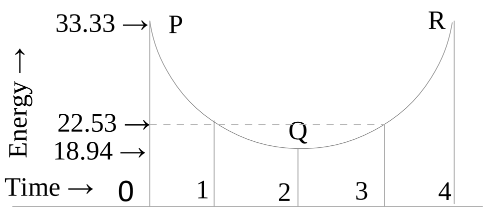


Fig- 3: Graph showing change in potential energy during expansion

Equation for the curve passing through the points P (0,33.33), Q(2,18.94) and R (4,33.33) can be given as, $y = ax^2+bx+c$

At P, $x = 0$, So, $y = c = 33.33$
At Q, $x = 2$, $y = 4a + 2b + c = 18.94$
At R, $x = 4$, $y = 16a + 4b + c = 33.33$
Solving, $a = 3.5975$; $b = -14.3925$
So at, $x = 1$, and $x = 3$, $y = 22.53$

The increase in speed is higher during the first half of expansion (refer table-2). This is because both internal kinetic energy and potential energy contribute to speed, whereas in the second half, the contribution is solely from internal kinetic energy, because potential energy increases in the second half. So we can take that the increase in speed is linear in the second half. By symmetry, the decrease in internal kinetic energy is linear in the first half. Thus external energy and internal kinetic energy at any given time can be calculated (refer table-2). It can be seen that the changes in the energy is perfectly symmetrical.

***(x). Changes in Force used, G and Space constant*:**

As explained earlier, if an *ideal mass* were part of the universe, its external energy will change from 16.67 to 50%. The change is uniform, and so at equal intervals will be as follows: 16.67, 25.00, 33.33, 41.67, 50.00 at t = 0, 1, 2, 3 and 4 respectively. At, t=1, the the external energy is normal and so the force available for interactions with other *masses* is 50%. We can assume that the force used by any *mass* at t =1, will be the same as that of the *ideal mass*.

During expansion, the speeds of the clusters increase. Consequent on this, both 'G of the universe' and the 'distance between clusters' increase. While G is proportional to 'square of the speed', distance is proportional to 'speed'. So force required for the interaction between *masses* is directly proportional to 'speed of the clusters'. As force used at t = 1 (when external energy is 32.2%, - refer table-2) is 50%, the force used at any time can be calculated. So the force used at halfway of expansion = 50x √(40.53/32.2) = 56.1%.

The G of the universe at any given time is equal to the G for the then speed of the exact middle cluster. The speed of the middle cluster at halfway, is $\sqrt{2}c/\pi$ and G[8] for unit speed is $7.7937\text{x}10^{-20}$ m^3/kgs^2.

$$\text{So G at halfway} = (7.7937\text{x}10^{-20}) (\sqrt{2}c/\pi)^2 = 1.4194\text{x}10^{-3}\ m^3/kgs^2.$$

If 's' is the space constant, then two *masses* having the same amount of matter will remain at a distance of Ms, that is, their boundaries just touch. The force used at halfway is 56.1% of the available gravity, $(Mc^2/4)(8.7556/10^4)$ - refer Para. 4.

$$\text{So, } GM^2/Ms = (Mc^2/4)(8.7556/10^4)(0.561)$$

$$\text{So 's' the space constant at halfway} = G/(c^2/4)(8.7556/10^4)(0.561) = 1.286\text{x}10^{-16}\ m/kg.$$

Thus knowing the percentage of external energy at different intervals, and the percentage of force used at t =1 (derived from the ideal mass), the force used, G and the space-constant at any given time can be calculated. The following table (table-3) gives the values of these at equal intervals during expansion.

	0	1	2	3	4	
Speed (External energy)	16.67	32.20	40.53	45.27	50.00	%
Force used	35.98	50.00	56.10	59.29	62.31	%
G of the universe	0.584	1.128	1.419	1.585	1.751	$\text{x}10^{-3}\ m^3/kgs^2$
Space-constant	0.825	1.146	1.286	1.359	1.428	$\text{x}10^{-16}\ m/kg$

Table-3: Changes in force used, G and Space-constant during expansion

(xi). Changes inside clusters:

There is no hierarchy between clusters and so changes start at the same instant in all the clusters (it is not spreading from one cluster to the other). So at any given instant, the energy and force ratios are the same for all clusters. The individual *masses*, however, remain at different levels in the hierarchical structure. The *masses* at the galactic centres have the highest internal energy, and these remain at the top level in the hierarchy. The energy-changes first affect the *masses* at the galactic centres, and gradually spread to other *masses*. So at any given time, *masses* have different speed- internal energy ratios.

As force is not transferred between *masses*, there is no hierarchy regarding force available, and so the force used for interaction with other *masses* is the same for all *masses* at any given time. However, as *masses* are part of orbiting systems, there will be slight fluctuations in the force-used depending on the position in its orbit; the force-used is the average value for that orbit.

When internal energy decreases, gravity required to balance it is less, and so during expansion, gravity used inside *masses* decreases gradually. But, as the force required for interaction with other *masses* fluctuates depending on the position in the orbit, gravity used inside show temporary periodical changes. The potential state of a mass depends on internal energy, elements present, its relative G and gravity used. So at any given time, masses will be at different temperatures, and some *masses* may get heated up temporarily for some period. But, eventually all *masses* reach cold states in the expanding phase.

7. Nature of the expanding phase:

Expansion is a process of internal energy changing into speed, and contraction, the reverse process. So the natures of the two phases are opposite. In the contracting phase, the direction of entropy reverses. So heat engines and life cannot exist in the contracting phase. The present view is that expansion is just a phenomenon at the cosmic level, and it has no direct role in our day to day life. But the new model visualizes that the expansion has a crucial role in our day to day life.

(i). Entropy:

As explained in a previous paper[10], entropy of a system is *the measure of the external energies of the bodies in it*. During expansion, the speeds of the clusters increase at the expense of their internal energies. The process spreads gradually to the individual *masses* and the external energies of atoms in them decrease. Thus, the entropy of the universe increases, while the entropy of the *masses* decrease. In the contracting phase, entropy of the universe decreases and the entropy of the *masses* increase.

(ii). Spontaneous/forced reactions and life:

In the expanding phase, the spontaneous reactions are exothermic (releasing energy); any endothermic reaction (absorbing energy) is a forced one. In the contracting phase, the situation is exactly opposite. It is the spontaneous release of energy that makes it possible for us to do work. So life can exist only in the expanding phase. It is the expansion that maintains life; but for the expansion, our energy sources would have been of no use.

(iii). Heat engines:

Heat engines work due to the temperature difference between the source and sink. But the crucial factor is that the sink should be 'open' so as to accommodate the heat released. The expanding universe acts as the sink and absorbs heat as speeds of clusters. So heat engines can work in the expanding phase. Internal energy of clusters changing into speed resembles the working of a heat engine. Naturally, heat engines will not work in the contracting phase.

(iv). Origin of Life:

The cooling of a hot planet is slow if the central *mass* is a hot star. So what happens is that initially the universe is hotter than the planet and so the energy of radiations falling on the planet gets accumulated in organic molecules. In that process, oxygen is released. Gradually universe becomes colder than the planet, and when it is sufficiently cold, spontaneous exothermic reactions takes place in the presence of oxygen. That is, the temperature difference becomes suitable for life, a heat engine, and life erupts from the primordial soup that got accumulated till that time.

(v). Stars and black holes:

As explained, the changes in internal energy can lead to fusion/fission reactions in a *mass*, if its energy is neither too low nor too high. The innermost clusters have the lowest energy and the outermost clusters have the highest energy. So nuclear reactions happen mainly in the middle region clusters. During expansion, internal energy decreases leading to fusion and formation of heavy elements. During contraction, the reverse process happens, and so just before expansion, there will be large amounts of hydrogen and helium in the middle region clusters.

The *masses* at the galactic centres account for a major portion of the dense elements in the middle region clusters. So the *masses* orbiting the galactic centres will contain large amounts of hydrogen at the beginning of expansion. As expansion proceeds, these become stars, and we are at the right place to observe these. By the time expansion is halfway, the masses at the galactic centres would have cooled and become black holes and many of the stars formed would have died out, the fusion reactions ending at iron.

8. The present state of the universe:

(i). Expansion at halfway:

The present temperature of the CBR is close to 2.7K, indicating that the expansion has reached nearly half way. As the rate of cooling is one degree Kelvin in 2.99 million years, it will take only 8 million years to reach exact half way. At exact halfway of expansion, the temperature is neutral (neither hot nor cold) and speed of expansion is steady (acceleration is zero). So the present period is the most suitable time for life to exist, and it is no surprise that we are here at the right time to observe these.

(ii). Age of the universe:

The age of the universe is the time elapsed since universe started expanding and so is equal to 15.64 billion years. Increase in radius of the universe till now is 7.82 billion light years. The oldest star (HD 140283) so far observed is estimated to be 14.46 ± 0.8 billion years old. Though the uncertainty in this figure is large, the proposed age is comparable to this, and there may be still older stars.

(iii). Evolution of life:

Life can exist only when conditions are not extreme. The complex brain structure requires a more moderate condition. So the period close to halfway is the most probable time that intelligent beings like humans emerge in the universe. The direction of evolution is thus determined by expansion. Evolution reaches its zenith at halfway, when 'brain-structures made up of matter' realizes what matter is, a self-realization. Thereafter, there will be gradual devolution, brain gradually losing its processing power, and ultimately all life forms will disappear, only to re-emerge in the next expanding phase.

(iv). The farthest source:

By the time expansion reaches halfway, light completes one revolution. So the farthest source, in terms of 'time taken by light' to reach us, will be nearly 15.46 billion years away. At that time, that source would have remained close to our present position, and now we are observing the returning rays. Being in the middle region, it would have moved out only 3.9 billion light years by this time, and so is not the farthest in terms of distance. As the source was not exactly at our present position, the returning rays reach us from one direction only, and so it will appear as a distance source. The rays from the source that remained at our exact position will take 8 million years more to reach here.

9. Amount of matter in the universe:

The proposed model visualizes that matter remains mainly as *masses*, many-body systems made up of atoms. At present, the amount of matter in stars, planets, etc. are estimated based on the concept of 'universal G'. But the proposed 'variable G' (proportional to square of the speed) implies that such estimates are wrong. For example, the speed of Sun is 6.7 times that of Earth, so its G should be 45 times that of Earth, and mass should be 1/45 of the present accepted value.

Similarly, the present concept based on 'straight-line motion of light' and 'metric expansion of space' view that the 'visible universe' extends up to 45.7 BLY from us. But the (proposed) circular path of light restricts our 'visibility' to 5 BLY, and the expansion being due to actual motion, the middle region clusters would have moved out only by 3.9 BLY. So the 'visible universe' extends up to 9 BLY only, and so the present estimate of density of universe is also wrong.

10. Agreement with observation:

The new model is in agreement with the following basic facts observed: (i). expanding universe (ii). accelerating expansion as at present (iii). existence of CBR (iv). uniformity on a large scale (v). existence of galaxies, clusters, filaments/voids (vi). increasing entropy (vii). existence of stars (hot *masses*) and black holes (cold *masses*) (viii). fusion reactions stopping at iron (ix). existence and evolution of life. The model is devoid of exotic concepts like four-dimensional space-time, dark matter, dark energy, etc.

11. The Earth- Moon distance:

The present accepted theories (Newtons laws and General Relativity) do not visualize any mass- distance relation for the large-scale structures of the universe; that is, the distance between bodies can be arbitrary. But the proposed model visualizes that distance at any given time depends on the then space-constant. The average Earth- Moon distance can be given by the relation $d = M_p s/2$, where M_p is the mass of Earth and 's' the present space-constant.

Earth- Moon distance $= (5.978 \times 10^{24})(1.286 \times 10^{-16}/2)$
$= 3.844 \times 10^{8}$m.

The measured Earth- Moon distance perfectly agrees with the theoretical value predicted by the model, and thus serves as the proof of the model.

12. Conclusion:

The 'pulsating model' and the 'space-constant' associated with it are just logical possibilities arising out of the assumption that *"energy and force of the fundamental particle are equal to* $mc^2/2$*"*. However, in the case of Earth- moon distance, the theoretical value obtained using the 'space-constant' agrees exactly with experimental data available. Either this is a '*very strange coincidence*' or a '*very strong proof*'. I would argue that it is a *very strong proof* that validates both the assumption and the model.

The pulsating model presents a clear physical structure of the universe: The required physical values associated with the universe have been derived; the past and future of the universe remains explained; and there are no unexplained concepts. Thus the model is complete in all respects, and agrees with all observational evidences available so far. So I claim that the proposed model is better than the existing ΛCDM model.

Reference:

[1]. Jose P Koshy, *The Fundamental Particle of Matter - Let's call it Photon,* http://vixra.org/abs/1401.0135

[2]. Jose P Koshy, *Quantization and Infinity as Intrinsic Properties: Entities Are Either Quantized or Infinite,* http://vixra.org/abs/1312.0245

[3]. Jose P Koshy, N*ewton was right: Light isparticles,* http://vixra.org/abs/1505.0042

[4]. Jose P Koshy, *Unification of Forces: a Complete Model with Theoretical Proof,* http://vixra.org/abs/1402.0103

[5]. Jose P Koshy, *Black holes have 'Cold Energy'* http://vixra.org/abs/1312.0092

[6]. Jose P Koshy, *Internal Structures of Electron, Neutron, Proton and Nuclei – Particle Masses Are not Arbitrary,* http://vixra.org/abs/1407.0037

[7]. Jose P Koshy, *Interactions in Many-Body Systems and the Concept of Chain-Formation,* http://vixra.org/abs/1511.0250

[8]. Jose P Koshy, *Theoretical Deduction of Universal Gravitational Constant,* http://vixra.org/abs/1510.0155

[9]. Jose P Koshy, *From Microcosm to Macrocosm: the Structure of the Physical World at a Glance,* http://vixra.org/abs/1401.0178

[10]. Jose P Koshy, *Redefining 'system' and 'entropy' in Physical Terms,* http://vixra.org/abs/1312.0002