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Research paper

Expansion of the universe and its correlation with dark energy

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Abstract

The Universe is expanding and science has got the relevant amount of evidence to prove that. The red shift of the distant galaxies prove that the Universe is expanding and at a good rate. The trouble is not with the expansion rather the force that is helping in this expansion. The Four Forces that is understood by physics are Gravitational Force, Electromagnetic Force, The Weak Force and The Strong Force. The four forces mentioned above unfortunately does not help in understanding the expansion of the Universe even after 13.8 billion years from the Big Bang. Initially it was thought that the Universe had an exponential expansion just after the Big Bang and this expansion will slow down before Gravity starts contracting the Universe. Well this theory got a setback after the Red Shift of the Galaxies showed that the Universe is still expanding.

The expansion is happening still which means that the Gravitational Force is not being able to drift the galaxies towards one another. So what could be the unknown force that is repelling the galaxies from one another? Scientists have been working on this issue and many new concepts have been developed. Many scientists have argued that there is some force that is repelling the Universe but understanding this force has been difficult till now. Major scientists now agree that there is a force that is repelling the Universe and this force is not the four fundamental forces that are known to us. They have termed this force as the Dark Energy.

What is this Dark Energy is a haunting question in today's world. Only around 5% of the observable Universe is known till date. The rest around 95% is still a mystery to us. Of that 95% around 68% is Dark Energy. So the importance of understanding this force is the need of the hour. This force can tell a lot about the formation of the Universe from the start or it can even enlighten us if the Universe is eternal.

The issue is as of now, this Dark Energy is hypothetical in nature as it has not been seen or felt by the instruments available to science today. The idea of Dark Energy goes to explain the expansion of the Universe, if Dark Energy is taken as some sort of Anti- Gravitational Force.

Einstein's theory of relativity talks of how space and time is intermingled with gravity. According to this theory space time gets modified due to the amount of matter that falls into the space. So if a planet sits on a space in the Universe it will cause a deviation in the space time field in such a way that it will accommodate the matter of the planet. So Einstein placed time as the fourth dimension and showed its importance in space. This theory stands true in majority of the cases in the Universe. The only hurdle being that inside the Black Hole this theory falters.

Einstein and Schrodinger did interact with one another after he had understood that the Universe was expanding through the theory presented by Hubble. Earlier Einstein had stated that the Universe was Static. To counter the exigency that space time changes with matter he had proposed a constant by the name Cosmological Constant. Later he took the constant away stating that it was his blunder not to understand that the Universe was Expanding. Schrodinger had proposed to put the Cosmological Constant in the right side of the equation. This meant the constant may change with time and be considered more of a variable force. Though, Einstein later did not agree to the idea. Still it can be considered that both of them were talking about an extra force but could not come to any conclusion on this.

Einstein in his special relativity theory had talked of conversion of energy to matter with his famous equation, E=mc^2. This meant that energy can be formed by matter and matter can be converted into energy. Though energy created from matter can be seen in Atom Bomb but matter created from energy is not seen. This paper will try to show how matter can be created from energy where Dark Energy acts as a Catalyst.

This paper also tries to analyze the concept of Dark Energy as a non interacting supermassive energy (NISE). The paper will try to see the relationship between expanding Universe and Dark energy. The paper will try to develop a new spectrum that can make Dark Energy or NISE as stated in the paper visible or understandable. The paper will also like to see the relationship between Dark Energy and Photon. The paper will try to show how energy is converted from matter with the help of Dark Energy.

Keywords: *Expansion of Universe; Dark Energy; Gravity; Photon; Black Hole; Matter; Red Shift.*

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1. Introduction

1.1. The red shift of universe

The expansion of Universe is not just a concept but now it is a proven fact that can be explained by a bit of physics. Everything that is known to us emits and absorbs a given wavelength of light. This wavelength falls in one of the spectrums of the electromagnetic wavelength. The expansion of the Universe was understood by looking into one of these wavelengths. Scientists can examine how far a star or galaxy is from us by looking at the wavelength of light emitted by the star or galaxy and in which part of the spectrum it falls in the electromagnetic wavelength. This also tells the scientist that over a period of time if the stars are coming near us or going away. Also, it gives an idea of at what speed the universe is moving.

As in sound wave it is known that a moving siren, sounds differently to a hearer depending on the wavelength and frequency of the sound wave. So as the siren approaches the hearer, it is heard the loudest and fades as it passes the hearer in the other direction. The fact being that near the hearer, the frequency is more and the wavelength is less and vice versa. This effect is also known as the Doppler effect of sound (Neipp, et al., 2003). Similarly in the light spectrum, if an object is nearing to the observer, the light spectrum will be in the blue end of the spectrum whereas if the object is moving away from the observer, the spectrum will be in the red end of the spectrum. When scientists see distant galaxies or stars, they have identified that the lines are shifted to the red end of the spectrum. So the wavelength is longer. This shift in the spectrum is also known as the Doppler Shift.

So if a star was coming towards us it would be blue shifted whereas if the star was going away from us it will be red shifted. It is seen that the far away galaxies are actually showing red shift. This has given us the idea that the Universe is expanding (Gupta, 2018). If the four fundamental forces that is the strong interacting force, the weak interacting force, the electromagnetic force and the gravitational force are considered, neither of them can explain an expanding Universe. Rather if Gravitational Force is taken into account then the Universe should have contracted as the celestial bodies would have started exerting enough gravitational pull to start the contraction of the Universe. Since that is not happening, so a lot of questions arise. Not only scientists get to know if the galaxies are drifting away but also with the degree of shift in the spectrum, scientists can calculate the speed of the moving galaxies. This helps the scientists to understand at what rate the stars or the galaxies are shifting.

1.2. Effect of gravity

It is known that gravity has an import part to play in the Universe. Gravity not only keeps humans glued to earth but also it has an effect on all celestial bodies and even on light. The earth is orbiting the sun and the moon is orbiting the earth because of this effect of gravity. It has been observed by scientists that even light is pulled by gravity (Taylor & Wheeler, 1992). In Black Hole, where immense mass is present in very less volume, gravity becomes intense. So even light is pulled in and cannot escape the Black Hole. So it is clear gravity pulls things towards one another and more the mass more will be the gravitational pull.

Gravitational force though decreases with distance and since Universe is huge, so as galaxies drifts apart, the gravitational pull decreases. Also Einstein had described that gravity behaves like a curve in space that wraps around every celestial body having mass (Dabholkar, 2005). According to gravitational force, every object having matter has an attraction to every other object having matter. Objects will attract one another with a force proportional to their masses and inversely proportional to the square of the distance between them (Kala, 2015). The equation stands as: $F = GMm/r^2$.

F is the force of gravitational attraction. The M and m represent the masses of the two objects in question. The r^2 is the distance between the two objects squared. G is the gravitational constant. It represents the constant proportionality between any two objects, no matter what their masses are. Gravitational constant is 6.672×10^{-11} N m^2 kg^{-2} .

1.3. Big bang and role of gravity

If the Big Bang Theory is taken to be true, then the Universe started from a point of Singularity that is a point with zero volume but infinite mass and energy. Big Bang theory generally tries to explain the formation of Universe from this point of Singularity till today that is 13.8 Billion years after the Big Bang (Saha & Choudhury, 2016). So it can be predicted here that for the Universe or space to spread an immense amount of energy would have been required and that energy would have superseded the effect of Gravitational Force.

The question that has always puzzled us is, what kind of energy helped the Big Bang to create such a gigantic Universe that is seen today and why the gravitational force could not contain it then and even now. It may be argued that if the Universe does have an adequate amount of matter then one day or the other the gravitational force will win over and the Universe will start to crumble. As the gravitational pull off the matter will bring all galaxies and stars closer to one another until every matter collapses back into a Singularity. This phenomenon is generally termed as the Big Crunch (Farnes, 2018).

The opposite side of this argument is that if the Universe did not contain adequate amount of matter then in no given circumstances, gravity will have the amount of force needed to crumble the Universe. So the Universe will constantly go on expanding indefinitely. As of now it can be told that the second argument is winning.

2. Literature review

It is believed that after the big bang which says that the universe starts from a point of singularity, it never stopped expanding. However, the rate of expansion became slow in the past and scientist thought that it was due to the gravity but now it has been proven that it is expanding in much higher rate till now (Riess et al.,1998). The major problem which lies with the scientists is what causes its expansion. In order to understand the expansion of the universe first let us know what scientists have a say on this. As soon as the big bang occurred from the point of singularity all the matter space, stars, planets were created. After Big Bang universe was growing exponentially and this was called inflation. Now just after the explosion of singularity when the universe was young, galaxies were much closer than today due to the strong effect of gravitational pull (Seeds, M.& Backman, D., 2012). So, the expansion of universe decelerated but as the universe continued to expand the distance between the galaxies increased. So, it is obvious that something is there in the space which is overcoming the effect of gravity and that is termed as dark energy (Ryden, Barbara, 2003). This expansion of the universe can be explained if we assume the existence of the cosmological constant (CC) which was proposed by Albert Einstein at that time which says that universe is neither expanding nor contracting but it is static (Ray,1992). Later he declared that this was his greatest mistake. Einstein introduced this

cosmological constant just to balance the gravity because CC acts against the gravity and prevent the universe to collapse by exerting negative pressure which is quite similar to dark energy. Generally, it has been considered that positive pressure and energy will have a gravitational effect on the universe so the negative pressure exerted by dark energy may be considered as "antigravity" (Man Ho Chan, 2015).

In cosmology, whatever we observe is only about 5%, the rest 26% and 69% constitutes of dark matter and dark energy respectively (Planck Collaboration et al. 2016). In the space, what we think as vacuum, is not actually vacuum it contains some kind of energy which is called vacuum energy (Milton, K.A., 2003). Since dark energy is considered to be spread throughout the space. So, many scientists thought that this vacuum energy is nothing but dark energy (Weinberg, 1989). If it is true then as the universe is expanding the amount of energy will also increase consequently the dark energy is increasing as the space continue to increase (Carroll & Ostlie, 2007).

As we know that universe is mostly made up of baryonic (normal) and non-baryonic matter but it is mostly dominated by a form of luminous matter (non-baryonic matter) which is called dark matter and this is almost five times richer than the baryonic matter (Ade et al., 2014). The evidence of dark matter showed in one of the experiment conducted by Zwicky in 1937 trying to estimate the total mass of the cluster of galaxies, it was found that the total mass calculated inferred from the motion of galaxies exceeded the estimated luminous masses of different astronomical objects by a very large fraction. So, it was very easy to understand that such clusters were not made up of ordinary matter but consist of dark matter (Zwicky, 1937). Later few more experiments support this statement and even revealed our own milky way galaxy is also dominated by dark energy (Rubin & Ford, Rubin, ford & Thonnard, 1980). It was also observed that the objects revolving the galaxy at larger distance from the center moves almost with the same velocity as the objects which is closer to the center (Jones & Lambourne, 2004). Unlike normal matter, dark matter does not emit, absorb or reflect light. It does not interact with the electromagnetic force (Nath, 2018). As far as the classification concern, non baryonic dark matter has been classified as hot dark matter (relativistic), cold dark matter (non-relativistic) and warm dark matter (semi-relativistic) (Gondolo, 2004).

3. Understanding the gap

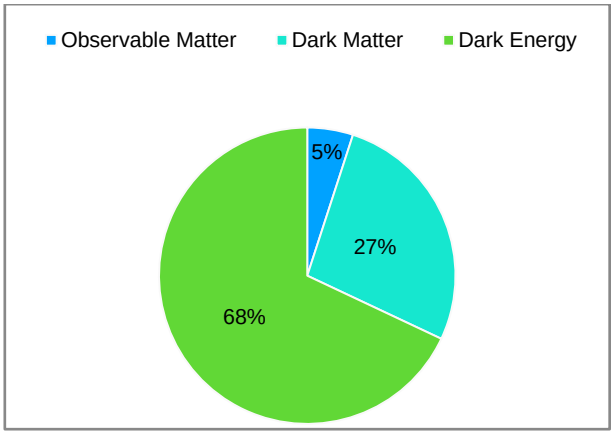

Fig. 1: Composition of the Universe.

The composition of the Universe shows us that the observable matter is just 5% and that brings in the gap. Only gravitational force of 5% matter would not have been able to hold this Universe together. Rather the galaxies would not have stayed and behaved in the way they do with the amount of matter available in them. The galaxies rotate in enormous speed and the observable matter would not have been able to keep the galaxy in place with just the gravitational force of the observable matter. This clearly means there are other materials or elements which is having attracting gravitational force that is binding the stars in the galaxies. So there must be some other form of matter that is helping gravity hold the Universe together.

So what could be these gap or other forms of matter that is helping the galaxies hold themselves together. It is evident that with electro-magnetic spectrum, these other form of matter cannot be seen. Though, the effect of this matter can be seen on the visible matter. These other form of matter is known as Dark Matter which was initially called the invisible matter. It has been observed that this invisible matter has an effect on the observable matter and that is how their existence can be certified.

Since Dark matter cannot be seen so understanding them has been a bit of an issue among scientists. Now scientist have another theory stating that the dark matter is composed of weakly interacting massive particles or WIMPs (Caldwell & Kamionkwoski, 2009). Scientists say that WIMPs are undiscovered subatomic particles. These WIMPs do not absorb or emit light and does not interact with photon (Robson, 2013). Though WIMPs is a theory but its authenticity is still questionable.

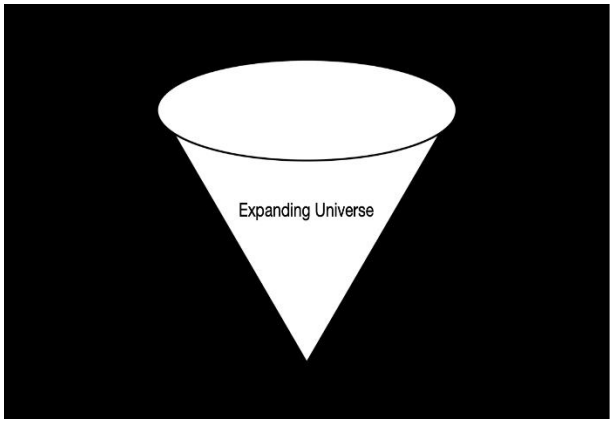

Fig. 2: Expansion of the Universe from Big Bang.

Our paper will not concentrate too much on Dark matter as the main focus of this paper is expansion of the Universe. It is clear that the Galaxies are not getting scattered due to the gravitational pull of Dark Matter in addition to the normal matter. In the same way, if our Universe was made up of the matter and dark matter, then the attraction force of the gravity would have started the Universe to contract. Instead of contracting the Universe is expanding. The expansion of the Universe is visible through the red shift of the far away galaxies.
If the Universe is expanding as it is evident, it means that the Gravitational force of the known matter in addition to the gravitational force of the Dark Matter is being outnumbered by some force that is acting as anti gravity. This anti gravity has to be more than the 5% of observable matter and 27% of dark matter. So what could be this anti gravitational force that is helping in the expansion of the Universe? From the above number it is evident that the anti gravitational force has to be more than the gravitational force as the anti gravitational force is winning.
It is presumed that there is another energy that is the Dark Energy that makes up 68% of the Universe (Schaf, 2015) and this energy is the cause of the expansion of the Universe. This paper will try to analyze if the Dark Energy is the gap that scientists and astronomers have been looking for the answers for the expansion of the Universe. Also this paper will try to see how Dark Energy is helping energy get transformed into matter.

4. Understanding dark energy

Till date there is no concrete model of Dark Energy though there are many hypotheses starting from Einstein's Cosmological Constant to Quintessence to Interacting Dark Energy to Variable Dark Energy and so on. This paper will look into Dark Energy as a possible fuel for interstellar travel. It is quite evident that if the Universe was made up of only observable matter then the Universe would have started to collapse but till date the Universe has shown no sign of collapsing. On the contrary, the Universe is expanding this means that the force of Dark Energy is much more than the force exerted by Gravity on Observable Matter and Dark Matter.
Dark Energy > Gravitational Force of Observable Matter + Gravitational Force exerted by Dark Matter
For a mathematical derivation let us take the Anti Gravitational Force of Dark Energy to be "AGd" where as the Gravitational Force of observable matter as "Gm" and force of Gravity from Dark Matter as "Gw". We know for the Galaxies to be stable, both force of gravity from observable matter and dark matter has to be added that means

Stable Galaxy= Gm+Gw, Whereas AGd> Gm+ Gw

How much Gd is more than Gw and Gm depends on the spread of Dark Energy, Dark Matter and observable matter in the Universe. So now if the known percentages are incorporated and the total Universe is taken as 100, then the equation for force will stand as.

68AGd>5Gm+ 27Gw

This means that even if the value of Gm and Gw were a bit more than AGd, then also AGd will be much more. So the expansion of Universe will carry on as the amount of AGd that is anti gravitational force of the Dark Energy exceeds the addition of the gravitational force of observable matter and Dark Matter. This goes to show the concept of Big Crunch will stand null and void. The only condition could be that the amount of Dark Matter and Observable matter goes on increasing while Dark Energy remains static or decreases. This is again not possible which will be shown in the later part of this paper.
Does Dark Energy always win over Gravitational force? The answer is no as inside the Black Hole, it can be observed that Gravitational Force wins over Dark Energy. It is known that Photon or Light cannot exit Black Hole as the Gravitational force is intense (Cardoso, et al., 2016). So the formula inside Black Hole reverses that is,

Gm+ Gw> AGd

That is the gravitational force exerted by observable matter that is the collapsing star which is refereed in the equation as "Gm" and the gravitational force exerted by Dark Matter present in Black Hole which is represented as "Gw" in the equation exceeds the anti gravitational force of the Dark Energy which is represented as "AGd" in the equation.
So, two resultant scenarios are formed. On one hand, inside Black Hole anti gravitational force is less than the gravitational force of observable matter and Dark Matter and on the other hand, in the rest of the Universe the Anti Gravitational force exceeds the gravitational force of observable matter and gravitational force of Dark Matter. It is quite evident from the two formulas that if the capacity of the three are taken out then may be the gravitation force of observable matter and dark matter may exceed the anti gravitational force of Dark Energy but due to the large amount of Dark Energy's presence in the Universe, Dark Energy wins and the Universe goes on accelerating.
Can space itself expand and can it create its own energy? The question is how space can create its own energy. The answer comes from the fact that how Big Bang started from a source of Singularity. This singularity is nothing but an energy burst of space itself. In the initial stages of Big Bang, the energy burst was extreme so the inflation was fast and as time passed the expansion rate slowed down and again it is going up. The reason being in the stages of galaxy and star formations, matter started taking up free space and that may have reduced the speed of expansion of space as gravitational force and force from dark matter had reduced the anti gravitational force of Dark Energy.
This paper will state Dark Energy as a form of Non Interacting Supermassive Energy (NISE). It is huge and it does not interact with any known or unknown matter directly but works as a Catalyst to change energy to matter and vice versa. Though Dark Energy does not directly interact with Photon but it pushes photons so that it assumes speed more than the speed of light and later it forms matter and decreases its energy. In this way, Photon and Dark Energy goes on increasing space and matter. It will be discussed in the later part of the paper. The main function of this energy is to create space itself. It is self evolving and does not need any stimulus for growth .This energy cannot be calculated by any known mathematics as this energy does not follow any physical pattern. The growth of this energy depends on itself.
According to Big Bang Theory, the Universe started from Singularity and in the first few minutes, things happened in extreme speed (Burago, 2017) even faster than the speed of light. This means that Dark Energy or NISE has the ability to even exceed the speed of light. It is also observed that far away galaxies are moving in much more speed than nearby galaxies. This clearly shows that the Universe is expanding fast with the help of Dark Energy (Slosar, 2019). As the expanding Universe will have less matter so the galaxies far away can move faster without hindrance, than galaxies near to us as there will be more matter. This is due to the fact that more matter means more

gravitational pull. On the contrary, less matter means less gravitational pull and more anti gravitational push. That may be the reason for far away galaxies moving in much more speed rather than galaxies near to us.

5. Electromagnetic spectrum & dark energy

It has already been stated above in this paper that the present electromagnetic spectrum is not enough to spot Dark Energy. If it had been possible, by now the scientists all over the globe would have been able to study the nature of Dark Energy which has been referred to as NISE in this paper. However, it might be possible to look at the Dark Energy if other characteristic wavelengths apart from the ones which are known today are discovered.

The existing electromagnetic spectrum consists of a continuum of all the forms of light known to us till date. It consists of electromagnetic waves which vibrate which leads to the propagation of waves. These vibrations happen between the photons. It is needless to say that all the waves which fall under the Electromagnetic Spectrum travel at the speed of light, that is, $3*10^8$ m/s. There are certain properties which are present in these electromagnetic waves. They are that of speed, frequency and wavelength. There is a relationship between these three parameters which have been given below:

Speed = frequency*wavelength

There is a relationship between wavelengths, frequency as well as energy. Short wavelengths have high frequency and long wavelengths have a low frequency. High frequency waves have high energy and low frequency waves have low energy.

Frequency=1/Wavelength

Increase in Frequency =Increase in Energy

Thus, the electromagnetic radiation comprises of a wide range of wavelengths or energies or frequencies which have got their characteristic properties. They are given as follows:

- Gamma rays
- X rays
- Ultraviolet
- Visible light
- Infra red
- Micro waves
- Radio waves

Gamma rays have got the highest frequency and the shortest wavelength and radio waves have the lowest frequency and the longest wavelength. The visible light which allows mankind to observe their surroundings has a wavelength between the ranges of 400 to 700 nanometers. A diagram of the Electromagnetic Spectrum is given as follows:

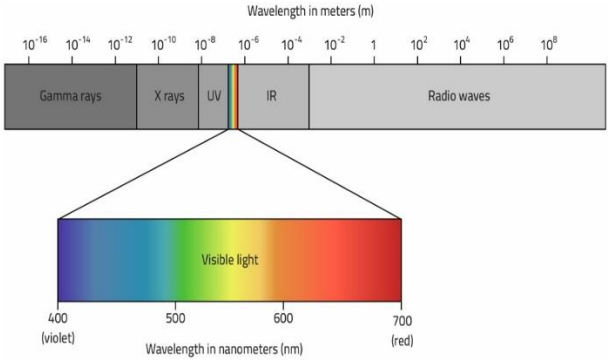

Fig. 3: Electromagnetic Spectrum.

As depicted in the diagram given above, currently the wave characteristics below 10^{-16} meters and above 10^8 meters are unknown. The possibility is that the energy which is present within this could be the answer to identify Dark Energy. It may be called the Dark Spectrum. This Dark spectrum could help us to identify the unobservable matter that is present in the universe. However, it is very difficult to ascertain its structure as of today, due to lack of advanced and more sensitive instruments. Still theoretically this paper will try to look into this spectrum and the possibility of its formation.

The color which is visible to us is mainly because of the reflection process. The wavelength that is reflected back to our eyes depicts a particular color. Light comes from various nanoscale patterns. Now, every surface has got some grooves. So, when light falls on this structure, the wavelength that is reflected back to the human eye determines the color. Similarly, if a structure appears blue, then the wavelength of blue color is reflected back. However, this is not the case with black and white color. Normally, white color reflects all the light and absorbs nothing and black light absorbs all the light and reflects nothing. Hence, the nanonoscale structures pertaining to the black or white color is disordered. Some scientists have been successful to produce colors out of these disordered surfaces by controlling the light which passes through them (Peng Mao, et al., 2020).

6. Dark energy and photon

Let us take an example of photon here. We know photon reacts both as a wave as well as a particle and it is known as wave-particle duality. So when photon travels through space it reacts as waves and when it strikes a matter it behaves like particle. The question comes how does

photon travel in empty space where there is no medium. The simple argument might be that since photon reacts as waves in space so it travels as waves. The problem with this principle is waves cannot propagate without medium. Maxwell in 1860 has said in his theory that light travels in space by a medium called "Ether".

Ether was later rejected but no definitive idea was given on the concept of how photon travelled without a medium in empty space. Einstein in his theory of special relativity in 1905 had stated that light travels in vacuum and had calculated the speed of light most accurately. Since then the concept of ether has died down. The problem though arises once Einstein theory of relativity is seen which states that once something approaches the speed of light its mass increases and its length contracts. When the object reaches the speed of light then its mass becomes infinite and length becomes zero. This made Einstein deduce that nothing can cross the speed of light. The argument to this theory is the concept of Singularity itself. As we know in both Big Bang and Black Hole, the mass of Singularity is infinite and its volume is zero (Bel, 1969). This point out that speed of light can easily be crossed.

It has been already discussed that the Universe is expanding at an alarming pace but what is this actual rate that is being referred to in this paper. Universe is expanding at around 68 km/s per megaparsec (1 megaparsec=3.26 million light years). If this calculation is taken forward then for a very distant object the speed will exceed the speed of light. The answer is simple that with mathematics only there will be a situation in this expanding Universe where a distant galaxy very far off will be travelling at a speed exceeding the speed of light. The problem is though mathematically we can deduce that but with Physics we cannot understand that situation as of now.

Let's consider Dark Energy into this situation. As already discussed, Dark Energy has been taken as an energy which acts just opposite to the gravitational energy. It has also been discussed that Dark Energy forms a medium for matter and dark matter to exist in it. So if Dark Energy is present throughout the Universe then can Dark Energy be a medium that lets photon travel in empty space? Let's look how light reacts to gravitational energy. It is seen that as Photons comes near a Black Hole its path get deviated and it bends from its property of travelling in a straight line. Photon bends near a black hole and circle around it in the Photon Sphere. Once it enters the Event Horizon, Photon totally disappears. This means gravity has the force needed to pull photon and distort its path or in extreme case that is in Black Hole it can consume the photon in totality. What happens to the photon inside the event horizon is still a question which is unanswered. Most probably photon from its wave form becomes matter that is sucked by the Black Hole Singularity.

So if gravity pulls the photon then Dark Energy should push the photon. It can be assumed that, in so called vacuum of space where there is no medium, Dark Energy acts as the medium for photon and pushes the waves that makes the Photon travel through space uninterrupted for infinite time until it comes and hits matter and changes from wave form to the particle form. As Universe expands at around 68 km/s per megaparsec at one point, the expansion of the Universe will supersede the speed at which photons travel. So a relationship between Dark Energy and photon can be formulated.

Electromagnetic spectrum just does not stop at 10^{-16} meters and above 10^{8} meters wavelength. The instruments present at this time may not be able to understand what lies between 10^{-16} meters and above 10^{8} meters of wavelength. So there could be spectrum below 10^{-16} meters and above 10^{8} meters of wavelength. Let's understand the given spectrum that is known is for the 5% Matter of the whole Universe. So once 95% of the Universe is talked about the spectrum has to be much larger so the spectrum could lie between the parameters of 10^{-16} meters and above 10^{8} meters of wavelength.

It is known that according to Einstein theory of special relativity that $E = mc^2$. This means that energy and matter is correlated. The difficulty is, though Atom Bomb and the nuclear reactors shows how energy can be created from matter the opposite is difficult. The difficulty is due to "c" that is speed of light. Now, if Dark Energy acts as anti gravity, it will be able to push the photons in such speed from all direction that at a given point in the universe, the photons will collide. It is known that if photons can be made to collide in extreme speed then this collision will result in formation of Electrons and Positrons. This is how matter can be created from energy where Dark Energy acts as the Catalyst. The reason why these events do not fall in the electromagnetic spectrum is due to the fact that Dark Energy dwells in the field below 10^{-16} meters wavelength as the frequency of Dark Matter is extremely high as it is accelerating at the expansion of the Universe.

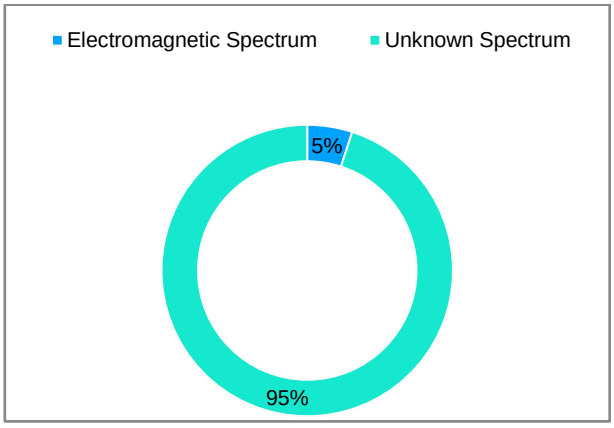

Fig. 4: The Unknown Spectrum.

It is quite evident that as Dark Energy is accelerating the Universe that means it is widely spread across the Universe. Though its force may not equal the gravitational force inside Black Hole, but in totality its force exceeds the force of the gravity. So it helps photons across the Universe to collide and form matter from energy. So Dark Energy keeps on pushing Photons so that its frequency exceeds the frequency of Gamma Rays and after that it is beyond the Electromagnetic spectrum known to us. The frequency of the photons goes on increasing which means the wavelength goes on decreasing to a certain limit which can be taken as 10^{-n}meters where the photons collides with one another and due to these collisions electrons and positrons are formed and the energy of the remaining photons change to 10^{n}meter of wavelength. As the photons collide it gives up its extreme energy. As we know frequency is directly related to energy so as energy of Photons fall its frequency also falls but its wavelength increases. This is again due to the fact that wavelength is inversely proportional to the frequency. So a circle of spectrum is formed where once energy is converted to mass, the remaining energy becomes extremely weak so frequency drastically decreases. So in totality the spectrum should be from 10^{-n} meter to 10^{n} of wavelength and till date only a fraction of that wavelength is understood.

(10^{-n} meter wavelength Photon collides with 10^{-n} meter wavelength Photon) Dark Energy used as Catalyst = Electron + Positron + 10^{-n} meter wavelength Photon

Once the value of "n" is known then the whole puzzle can be solved and a complete spectrum can be drawn from where energy and matter can interchange.

7. Dark energy and expansion of universe

This paper by now has shown that Dark Energy acts as catalyst and can change energy into matter and of course matter into energy. If the paper looks from the Big Bang it could be understood that Dark Energy was the fifth fundamental force that helped in developing all the Observable Matter from extreme energy present in the Singularity. It helped photons collide and by virtue of that matter started forming and all the galaxies, star,, planets etc that is seen today were created.

It means that photons were present from the Big Bang, but it had immense frequency more than that we can observe or understand so it could not be detected. Though through advancement of science one day the adequate amount of technology would be there to see beyond Gamma Rays and on that day these early photons and the influence of Dark Energy can be understood even better.

As matter started forming, photons started losing its frequency and travelled in an optimal speed that is the speed of light we know of. This means that at a given point of time in Big Bang Photons would have travelled in a speed which must have been several times faster than the speed of light.

As the photon lost energy, Dark Energy started creating space devoid of matter so we see vast amount of the Universe that is devoid of matter. In this vast naked space, Dark Energy will try to accelerate photons again so that the colliding frequency is reached at a point. So in totality Dark Energy helps in increasing the speed of photons and as it is known that frequency is directly proportional to speed. Increase in the frequency of photons leads to the collision of photons which in return result in the formation of matter. This eternal crossing between energy and matter is stretching the Universe and it is expanding. As Dark Energy is vast so this expansion will go on eternally until gravity of all the observable matter and Dark Matter will exceed the anti gravitational force of Dark Energy. As of now it seems impossible as Matter is only 5% and Dark Matter is 27% where as Dark Energy is 68% of the Universe.

8. Dark energy and singularity

Now if Dark Energy can generate itself then the anti gravitational force constantly will go on increasing. So if more galaxies or more matter is formed it will not hamper the expansion of the universe as Dark Energy will go on developing itself.

The question is, if Dark Energy is so vast why can't it be seen or why it does not directly interact with other matter in our Universe. Why only Dark Energy influences the speed of photon and plays with conversion of energy to matter. The simple reason could be that all matter and dark matter might be standing on the framework of this Dark Matter and the interaction is in some kind of inter dimensional that is not understandable by us till date. The simple reason is that in Black Hole as time and space merge in the singularity, what kind of dimension is formed is not understood by us. As mathematics and physics fails to explain Singularity, our knowledge of physics does not let us understand Black Hole or Big Bang singularity in similar way, the inter dimensional interaction between Dark Matter, Dark Energy and Observable Matter may not be understandable to us right now.

In Universe, Singularity can be seen twice once in Big Bang and in Black Hole (Malkiewicz & Piechocki, 2006). In one, Universe is created and in the other, Huge Stars Die. Are these Singularities different? It is again debatable as Big Bang Singularity is naked where as Black Hole Singularity is protected by Event Horizon. Still the definition of both the singularity is same as both talks of a point with zero volume and infinite energy and mass. Big Bang singularity is an idea only whereas the Black Hole Singularity formation can be observed by the death of a neutron star; etc. Recently Hubble has seen black hole formation from a star without even supernova formation.

If both the singularity definition is same then why from every black hole a Big Bang is not forming the reason could be Dark Energy again. As Dark Energy creates the space in Big Bang, it acted as antigravity and helped in spreading space throughout the universe. But inside black hole as gravity is immense effect of Dark Energy becomes minimal so expansion into another universe does not happen. So it can be stated that Dark Energy acted as Catalyst in the Singularity of Big Bang and felicitates its growth dramatically whereas in Black Hole Singularity Dark Energy cannot act as Catalyst due to presence of intense gravity. This leads to the conclusion that there is no possibility of parallel Universes or overlapping Universes from Black Hole.

It can be argued that Dark Energy has a direct impact on Big Bang Singularity but fails to do so in Black Hole Singularity due the presence of the gravitational force. This also goes to show that indeed Dark Energy is an anti gravitational force and it has its footprint in every part of the Universe and specially those parts where matter is less and vast space is more.

9. Limitations of the paper

This paper has tried to analyze the expansion of Universe and the causes behind it. The paper has tried to show that Dark Energy could be one of the candidates for the expansion of the Universe. The paper has tried to show that Dark Energy is a Non Interactive Supermassive Energy (NISE). The paper has also tried to analyze that how Dark Energy interacts with Photons and increases its frequency.

As the knowledge of Dark Energy till date is very limited so the paper might not have been able to give details how to visualize Dark Energy in a new spectrum. Also the paper has tried hard to give as much as theory and mathematical interpretation as possible still there could be few fields that the paper has over looked. As the theory of Dark Energy is very hard to understand so the paper may look to be depending on lot of speculations. The authors acknowledge that, till date there is no instrument that can see Dark Energy so lot of it has to be philosophical. It may be understood that the basic of any scientific evolution is philosophy so this paper one day could be an inspiration for scientists to look into the unknown.

10. Further scope of study

The paper gives a light to the theory of expansion of universe and the energy responsible for it that is Dark Energy. The paper tried to show how to understand Dark Energy through a different spectrum. The paper also tried to give a formula on Dark Energy and Photon. Finally the paper tried to see how Dark Energy as the catalyst for the expansion of the Universe.
There is huge scope of work from this paper. Researchers can look into the details of the mathematical interpretation and improvise it. Also further research can be done to understand Dark Energy better. The concept of NISE can later change the name of Dark Energy as a whole also. Further research can be done to look into the exact amount of anti gravity created by Dark Energy. Also there is huge scope of research for development of Dark Spectrum.

11. Conclusion

The paper has shown that there is direct relationship between expansion of the Universe and Dark Energy. The paper explained that Dark Energy is a form of anti gravitational force. The paper tried to give Dark Energy a new name by the nomenclature Non Interactive Super-massive Energy or in a short form "NISE". The paper also gave a relationship between dark energy and photon and tries to develop a new spectrum through which dark energy may be understood better. The paper also tried to derive a mathematical interpretation so that understanding dark energy becomes easier.
The paper tried to show how Dark Energy increases frequency and energy of photons so that they can collide and form matter. It is understood from the paper that collision of photons gives up its extreme energy. As a result matter is created in the form of electron and positron. Also the photons remain with extremely low frequency or high wavelength.. So a circle of spectrum is formed where once energy is converted to mass the remaining energy becomes extremely weak so frequency drastically decreases. So in totality the spectrum should be from 10^{-n} meter to 10^{n} of wavelength and till date only a fraction of that wavelength is understood.
This shows how the conversion of energy to matter can create a new electromagnetic spectrum with 10^{-n} to 10^{n} wavelength. The paper also showed how with the help of Dark Energy, photons can travel beyond the speed of light. The paper also by looking into the relationship between Dark Energy and Singularity showed that parallel Universe concept is not possible at all.
The paper also showed that as Dark Energy makes 68% of the Universe so even if inside Black Hole Gravitational force of observable matter and Dark Matter becomes more than the Anti Gravitational force of Dark Energy .Still in totality due to the mare volume of Dark Energy it will always win over the combined gravitational force of Observable Matter and Dark Matter.
Dark Energy is the least known and understanding it in totality can give us answer to several Astronomy based questions that are not understood till date. Dark Energy could be considered as the fifth fundamental force that is needed to be added to the four existing fundamental forces. If Anti Gravitational force is added as the fifth fundamental force then explaining the expansion of the Universe will be relatively simpler.

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