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## A Step Forward Progress in Physics and Cosmology with an Alternative Approach to General Relativity

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# A Step Forward Progress in Physics and Cosmology with an Alternative Approach to General Relativity

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With a view that GTR has a way to account for the nature dark energy if traced back to the nature of spacetime just before cosmic inflation. I mainly review GTR and its subject equation. Also, with the view that all properties of spacetime are linked, I review major observatory points from LIGO project on gravitational waves, results from photometric observations of type Ia supernovae on the expansion of the universe. Finally, dark energy's fellow; normal energy (Electromagnetic radiation, EMR) must not be left out from solving the puzzle and must take a review. I present a theoretical concept from GTR awaiting experimental prove. This concept accounts for the nature of dark energy arising from a non-stretched spacetime just before the cosmic inflation, relating the vacuum energy as true a property of the non-stretched spacetime which has an opposite effect as EMR. This concept emerging from GTR gives the experimentalists/cosmologists an idea on nature of dark energy.

**Keywords:** space; dark energy; energy; fabric; universe.

## I. INTRODUCTION

Physics and cosmology welcome the idea that more space can come into existence by expansion. Hubble space telescope observations of very distant supernovae showed that a long time ago, the universe was expanding slowly than its rate today. The nature of spacetime at the outer-space is observed to be very thick and a better illustration of its expansion is like the expansion of an elastic rubber, if two points are marked apart on an elastic rubber, the distance between the two points increases by stretching

(expansion) the elastic rubber, stretching the elastic rubber increases the length of the elastic rubber itself and reduces its thickness depending on how far the elastic rubber is stretched. This simple illustration is the idea behind the observational discovery of the expansion of the universe. The summary of the illustration implies that although the elastic rubber is stretched or expanded, there was a default length and thickness of the elastic rubber just before it was stretched. Using this illustration in cosmology, the universe is expanding which means the distance between two points will increase over time, the elastic rubber in this case is spacetime. Although spacetime is expanding, theorists and astronomers have refused to indicate or observe that spacetime itself is also losing its thickness. It can only be regarded as magical if more space can come into existence without emerging from its previous form. This implies that from the point of cosmic inflation, spacetime kept stretching up to this point creating expansion. However, there is a default nature of spacetime that was present just before cosmic inflation, the fact that dark energy had driven the expansion of spacetime right from the big bang means that the nature of dark energy can be easily described if that default nature of spacetime is presented. In this paper, as an attempt to present this default nature that'll lead to the description of dark energy, I review the main concept of GTR that describes gravity as a property of space from its curvature, this review of GTR discovers a missing function of gravity that is similar to that of dark energy, this is presented in Section 2.0. Gravitational wave effect on spacetime itself is linked to this missing function of gravity, observatory points on the origin and behavior of gravitational waves from LIGO to check for this effect is presented in Section 2.1. With the observatory points, the new alternative approach to GTR is presented in Section 2.2. A test to prove this new concept is done mathematically in Section 2.3. Section 3 and 3.1 presents points and evidences on the expansion and acceleration of the universe from the type Ia and High z supernovae team. As related to dark energy, possible properties of this energy fluid are also presented. The stars are the main source of EMR. Other than the death of a planet or any other planetary body, the death of stars results into black holes causing the deformation of spacetime exhibiting a strong

gravitational acceleration. A view that EMR will provide a huge lead to dark energy is presented in Section 4 and 4.1. Section 5 presents a new theoretical concept from GTR with the summary of all the major points from other sections and describing the nature of dark energy leaving a clue for the astronomers/experimentalists on how to prove this concept.

## II. GENERAL RELATIVITY

General theory of Relativity (GTR) is the latest description of gravitation in modern physics. It is a geometric theory of gravitation proposed and published by Albert Einstein in 1916 [2,4].

Einstein also derived his field equations describing the relation between the geometry of a four-dimensional pseudo-Riemannian manifold representing spacetime, and the energy momentum in spacetime, this was different from the Newtonian concept in terms of the source. In Newtonian gravity, the source is mass. In GTR, mass is described as a general quantity known as the energy-momentum tensor. Newton's law has since been suspended by Albert Einstein's Theory of General Relativity, but it is still used as an approximation of the effects of gravity in most applications.

Newton described gravity as a force of attraction between two bodies; tugging between two bodies depends on how far apart the two bodies lie and how massive they are. As a small object of mass on the surface of the earth, the center of the earth will pull you toward it keeping you to the ground. However, GTR introduces empty space as an entity that has properties instead of nothing. GTR describes gravity as actually the result of a mass bending spacetime resulting into a curvature, the curvature of space-time then influences how mass-energy are spread. With this concept, GTR had predicted some observational evidence that we see today such as gravitational lensing, changes in the orbit of Mercury, Gravitational redshift, gravitational waves etc.

Introducing the field equation of GTR, the subject equation of GTR is

$$G_{\mu\nu} + g_{\mu\nu}\Lambda = 8\pi G/c^4(T_{\mu\nu})$$

$g_{\mu\nu}$ - Metric tensor

$\Lambda$ - Cosmological constant

$G$  - Newton's gravitational constant

$G_{\mu\nu}$ -Einstein tensor

$c$  - Speed of light

$T_{\mu\nu}$ - Stress-energy tensor

In this part review, with the aim of not condemning any part of GTR but adding modifications with prove, some review points are presented for readers to access before introducing this new concept. These review points are as follows;

- 1) With the existence of the Newtonian concept of gravity and General Relativity, the nature of gravity

is not yet understood completely. In terms of its quantum form.

- 2) The Newtonian constant ( $G$ ) is present in the field equation of GTR, this implies that at some point, the Newtonian concept of gravity is correct.
- 3) Why do we have gravitational waves as ripples in spacetime predicted by GTR, but its theory has not emphasized on the fact that gravity is not just a consequence of spacetime curvature.
- 4) In the view of the nature of space inside a planet. Why does mass/energy curve spacetime at the outer space while an object of mass inside a planet will fall freely which GTR claims to move along a geodesic.
- 5) Why is the nature of space inside a planet different from that of the outer space?

Based on this pre-review points, the alternative approach to GTR introduced in this paper will be based around these 5 points and backed up by the discovery of gravitational waves.

Einstein field equation describes the geometry of spacetime, and its curvature caused by mass/energy. Einstein equation involves matrices, calculus, tensors etc.

In this review for an alternative approach, the geometry of spacetime or spacetime curvature is not needed, the modifications do not involve matrices or calculus. Therefore, we eliminate the tensors and scalar curvature in the field equation. Thus, there is need for the Newtonian constant ( $G$ ) and the speed of light ( $c$ ). The discovery and detection of gravitational waves plays an important role in developing this new approach.

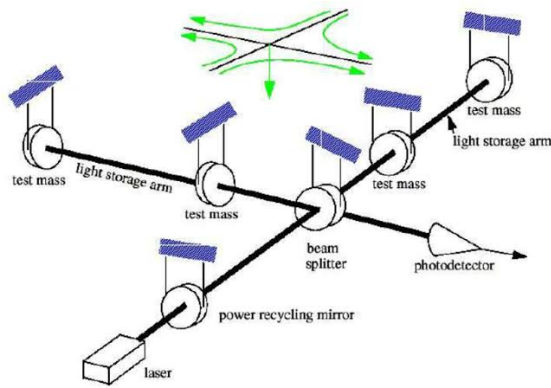
### a) Gravitational Waves

Some review points from the detection and discovery of gravitational waves must be presented to aid this new concept.

LIGO (Laser Interferometer Gravitational- Wave Observatory) is a large-scale physics experiment to detect cosmic gravitational waves. With the aim of detecting gravitational by laser interferometry, two observatories were built in United States at Hanford site, Washington and Livingston, Louisiana[9].

Four years ago, the LIGO and Virgo collaborations announced the first observation of gravitation waves (GW150914) matching the predictions of GTR.

The flickering distortions of spacetime called gravitational waves are not easy but tricky to detect, and only managed to detect in recent years.



**Figure 1:** Basic schematic of LIGO's interferometer with an incoming gravitational wave depicted as arriving from directly above the detector

The LIGO's two four-kilometer-long arms is in L-shape, as a wave passes through, one arm is stretched and the other is shortened. Lasers moving up and down the arms will measure the change in length indicating that a gravitational wave has passed through.

Points used from the detection of gravitational waves from LIGO in [3,9,10,21];

- 1) The velocity, acceleration, trajectories of object changes as ripples in spacetime propagate.
- 2) You can't see the effects of gravitational waves but can measure how they affect an object as they pass through.
- 3) As a gravitational wave travels through spacetime, it causes it to stretch in one direction and compress in the other.
- 4) Gravitational wave causes any object that occupies that region of spacetime to stretch and compress as it passes.

*The Question is, what exactly is the root of gravitational wave?*

Gravitational waves are emitted by accelerated masses. They propagate at the speed of light and are transverse waves much as electromagnetic waves, but rather than exerting forces on charges, they distort the space perpendicular to the direction along which they propagate, alternatively stretching space in the east-west direction while simultaneously compressing space in the north-south direction (Rainer Weiss. Nobel Lecture, Rev Mod Phys 90(4), 040501, 2018) [21].

A major instance of a wave is Light (EMR). There was a debate on the movement of Electromagnetic radiation. This was either as a wave or a particle. But at the end of the 19<sup>th</sup> century, Albert Einstein revived it as a dual nature (as both a particle and a wave)[12]. However, the waves as particle combined comes from a source.

In terms of gravitational waves, based on this new approach, gravitational waves can exist as both a particle and a wave. These particles or waves propagate

from a source known as spacetime. Gravitational waves only emerge when distortion takes place on spacetime due to pressure either by a mass or energy. It is an unknown fact that gravitational waves prove that gravity is not only as a result of spacetime curvature but also as a result of distortion of spacetime by mass/energy.

A major review point is presented from the observations from the LIGO observations on gravitational waves from [9, 21]. The major point is "When gravitational waves travel, it causes spacetime to stretch in one direction and compress in the other".

#### b) *New Alternative Approach to General Theory of Relativity*

With this major point, the new approach to GTR can be presented. An aspect of cosmology which is the stretching/expansion of spacetime hasn't been given much attention over the years.

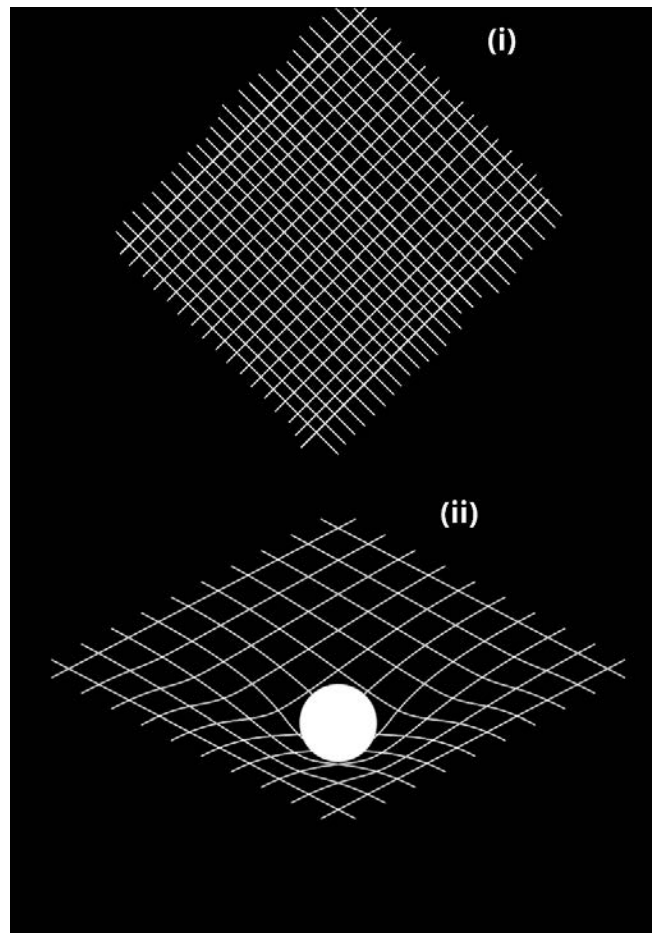
Again, it'll be magical if more space of the same nature just seems to appear instead of emerging from its initial form. There is only one default nature of spacetime, it is the nature of spacetime before cosmic inflation. Spacetime exist with two major properties known as gravity and a positive energy. The same way, there are two ways that spacetime can be stretched/expanded; naturally by the effect of its positive energy and by provoking spacetime to unleashing gravity by the application of pressure/stress through mass/energy on spacetime. Gravity then in turn stretches the spacetime in the same direction from the pressure/stress. This is the exact effect of the waves of gravity (gravitational waves) on spacetime.

This definition of gravity describes its actual nature as an effect of distortion and curvature of spacetime. Hence, deep explanation and prove is needed.

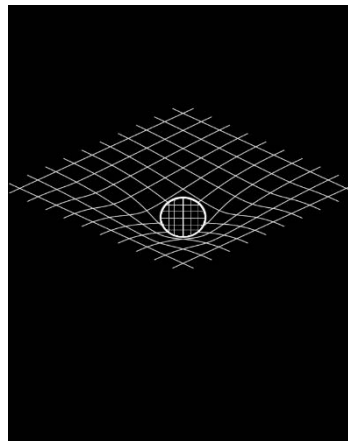
The discovery and detection of gravitational wave [3,9] is an experimental prove. Thus, proving of this new concept mathematically is needed. To prove this concept mathematically, the nature of spacetime before cosmic inflation must be present mathematically. An attempt to discover the nature of spacetime before cosmic inflation will result into an illustration.

In this alternative approach, spacetime has only one true nature as a very thick or stiff entity. "One way to say it is, the stiffness (Young's modulus) of space at a distortion frequency of 100Hz is  $10^{20}$  larger than steel" (Rainer Weiss. Nobel Lecture, Rev Mod Phys 90(4), 040501, 2018) [21]. Any other nature of spacetime besides this default nature is a stretched spacetime. The nature of spacetime on earth is observed to very free because spacetime initially on earth on the point of creation was the default nature but was stretched to a very free space.

An illustration (with figures) describing how spacetime inside planetary bodies are stretched.



*Figure 2:* The image (i) in Figure 2 will represent the default nature of spacetime. (ii) shows a spherical body exerting pressure on the default nature of spacetime



*Figure 3*

At the point of creation of the universe, the default nature of spacetime was everywhere, these planets or planetary bodies that exerted pressure on the default spacetime also contained the same default spacetime inside them (shown in figure 3). Distortion means that a referred thing or entity has gone out of shape. From figure 3, it is seen that a spherical body exerting pressure on the default spacetime creates curvature of spacetime, the fact that a curvature

emerges means that a distortion due to pressure has taken place. Thus, resulting to the release of gravity.



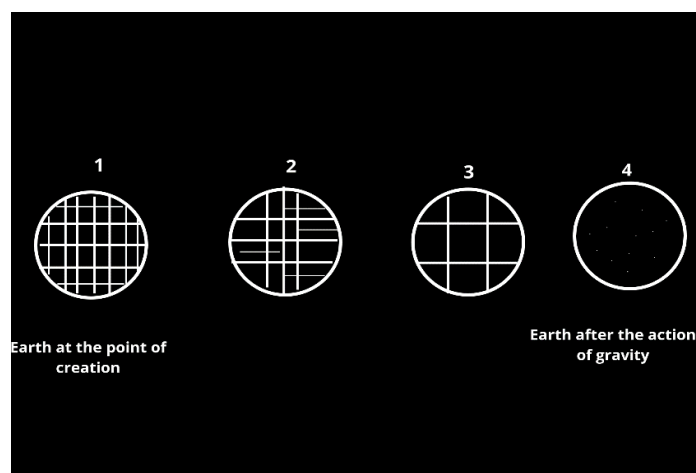


Figure 4

There are many bodies that exerted pressure on the default spacetime at the outer space during the point of creation. Using earth as an example, figure 4 shows the stretching of the default nature of spacetime inside earth by gravity the moment it was found to exert pressure. 2 & 3 in figure 4 shows the stretching of spacetime process done by gravity, 4 shows the final nature.

The only way more space can come into existence is by stretching (expansion). This can be done either by gravity or spacetime energy fluid. Just like an elastic rubber instance, stretching of spacetime results into a reduction in thickness. Unfortunately, an instrument or device that can measure the thickness of spacetime in different places doesn't exist. However, a mathematical prove of this concept will also help in the invention of that device.

General Theory of Relativity suspended the application of the Newtonian gravity concept. Have Physics asked this question; Why can we use the Newtonian concept to find the mass of a planet with a given acceleration due to gravity but not GTR. This is simply because equations of GTR are more complex, explaining basically about curvature which requires the use of tensors and leaving the details for distortion. Why don't we use a simpler approach to solve problems about our universe? Solutions to problems about our universe might be looking at us, but we choose to go deep and get stocked.

At the outer space, we have a thick spacetime nature, but the discovery of the expansion of the universe means that although the nature of spacetime is still thick and might not be noticed but it is a stretched version of the default nature.

However, here's the clue. A contained stretched spacetime cannot be reversed back to its default nature. Hence, this implies that the present nature of spacetime inside earth and other planets exerting pressure on spacetime has been stretched a long time ago by gravity. These planets with these stretched natures of

spacetime just rotate about at the outer space and the effect of gravity goes unnoticed because the stretching has been done a long time ago (once it was found to exert pressure).

The bigger the mass, the higher the pressure exerted on spacetime, the more stretched the spacetime inside that object/planet of mass is, involving the area of the planet.

#### c) Mathematical Test

Since the stretching inside a planet has been done a long time ago, this implies that we can find the value of the default nature of spacetime before or at cosmic inflation.

The parameters needed to find the default nature of spacetime are;

Mass of a planet (M)

Radius of a planet (r)

Value of stretched spacetime inside a planet ( $s_{\text{stretched}}$ )

Default nature of spacetime ( $S_{\text{default}}$ )

There's still one more problem, to get the default nature of spacetime, we must get the value of a stretched spacetime in a planet. GTR addressed object in free fall as moving along a geodesic. In Newtonian concept, all object in free fall accelerates towards the center with the same speed. In this alternative approach to GTR, the nature of the stretched spacetime inside a planet is the main reason why objects accelerate towards the center with the same speed. Thus, the value of the nature of stretched spacetime inside a planet is  $(1/g)$  i.e the inverse of acceleration due to gravity of a planet.

Parameters for earth will be used for first trial to test for the default nature of spacetime.

Presenting parameters for earth from [13];

$g$  for earth:  $9.8 \text{ ms}^{-2}$

Mass of earth:  $5.97 \times 10^{24} \text{ kg}$

Radius of earth:  $6.38 \times 10^6 \text{ m}$

$S_{\text{stretched}}$  of earth (1/g):  $1/9.8 = 0.102$

$S_{\text{default}}$ : ?

I formed a formula with these four parameters for a planet. Spacetime is of one nature ( $S_{\text{default}}$ ). At cosmic inflation, it was initially everywhere and inside a planet also. Since it was everywhere, the aim is to find out if stretching of the default spacetime occurs on the line of pressure. Automatically, all planets exert pressure on spacetime due to their mass. The technique from this formula is that the value of the  $S_{\text{default}}$  will be reduced to a lower value to signify that stretching(expansion) has been done. Spacetime inside a planet is based on its area, we are dealing with spherical planets, the radius will be squared ( $r^2$ ). Representing the area,  $r^2$  will be multiplied by  $S_{\text{default}}$ . Since the mass exerts the pressure, a division sign must be between  $S_{\text{default}}$  multiplied by  $r^2$  and the mass, this will result into a stretched value of spacetime. The planet is on the line of pressure.

$$S_{\text{default}} \times r^2 / M = S_{\text{stretched}}$$

Thus, the value of  $S_{\text{default}}$  is the unknown, the formula will now be;

$$S_{\text{default}} = S_{\text{stretched}} \times M / r^2$$

Using the values for earth, we have

$$S_{\text{default}} = 0.102 \times 5.87 \times 10^{24} / (6.4 \times 10^6)^2$$

$$S_{\text{default}} = 1.50 \times 10^{10}$$

Since all planets exerts pressure on spacetime, parameters for more three planets must be used to confirm this value.

Presenting parameters for mars from [13];

g for mars:  $3.72 \text{ms}^{-2}$

Mass of mars:  $6.46 \times 10^{23} \text{kg}$

Radius of mars:  $3.39 \times 10^6 \text{m}$

$S_{\text{stretched}}$  of mars: (1/g) =  $1/3.72 = 0.268$

$S_{\text{default}} = ?$

Using values for mars, we have

$$S_{\text{default}} = S_{\text{stretched}} \times M / r^2$$

$$S_{\text{default}} = 0.268 \times 6.46 \times 10^{23} / (3.39 \times 10^6)^2$$

$$S_{\text{default}} = 1.50 \times 10^{10}$$

Presenting parameters for Neptune from[13];

g for Neptune:  $13.3 \text{ms}^{-2}$

Mass of Neptune:  $1.03 \times 10^{26} \text{kg}$

radius of Neptune:  $2.27 \times 10^7 \text{m}$

$S_{\text{stretched}}$  of Neptune (1/g): 0.075

$S_{\text{default}} = ?$

Using values for Neptune, we have

$$S_{\text{default}} = S_{\text{stretched}} \times M / r^2$$

$$S_{\text{default}} = 0.075 \times 1.03 \times 10^{26} / (2.27 \times 10^7)^2$$

$$S_{\text{default}} = 1.50 \times 10^{10}$$

The last test will be with parameters for sun from [13];  
g for sun:  $274 \text{ms}^{-2}$

Mass of Sun:  $1.989 \times 10^{30} \text{kg}$

radius of Sun:  $6.96 \times 10^8 \text{m}$

$S_{\text{stretched}}$  of Sun (1/g): 0.00364

$S_{\text{default}} = ?$

Using values for Sun, we have

$$S_{\text{default}} = S_{\text{stretched}} \times M / r^2$$

$$S_{\text{default}} = 0.00364 \times 1.989 \times 10^{30} / (6.96 \times 10^8)^2$$

$$S_{\text{default}} = 1.50 \times 10^{10}$$

The result of this mathematical test with the parameters for three planets and the sun shows that with this concept of stretching by the waves of gravity, the value of the default nature of spacetime before cosmic inflation is approximately ( $1.50 \times 10^{10}$ ) as a constant. Hence, with the value of the default nature of spacetime as  $1.50 \times 10^{10}$ , the value of the nature of stretched spacetime in any planetary body can be calculated.

From the mathematical results, earth at the point of creation contained the default nature of spacetime ( $1.50 \times 10^{10}$ ), once earth exerted pressure on the default spacetime at the outer space, this value ( $1.50 \times 10^{10}$ ) of spacetime was reduced (stretched) to 0.102 by the action of gravity (line of pressure). This value (0.102) signifies a very free space.

Parameters for different planets and planetary bodies can be applied to get this default nature of spacetime before cosmic inflation. This is to prove this new concept of stretched spacetime by gravity. With these results, it is revealed that when a given mass and radius of a spherical planet exert pressure on the default nature of spacetime, the default nature of spacetime at the line of pressure (inside the planet) stretches.

*Note:* The usual unit of  $S_{\text{default}}$  is  $\text{m}^{-3} \cdot \text{kg}^1 \cdot \text{s}^2$  and the unit of  $S_{\text{stretched}}$  is  $\text{ms}^{-2}$ , but approved unit will be decided in future. For non- spherical planets or planetary bodies, the area of the body will be replaced with  $r^2$ .

GTR defines gravity as a result of curvature of spacetime, this curvature explains a smaller planet's rotation around a bigger planet, and the attraction of the smaller planet to the big one. GTR and the Newtonian gravitational concept does not specifically explain why objects are attracted to their planet's center. It is known that gravity is the reason why an object on the surface of a planet is attracted to its center but there's no specific reason and it is not curvature. For example, imagine a planet contains a very thick spacetime just like the default nature, the curvature outside will enable the

attraction of an object to it, but once that object gets inside the planet, the object will float. Therefore, it cannot move downwards talk less of reaching the center. However, planet formation during the big bang is not known, only our creator can say but the only way the lands of planet earth and everything beneath the lands does not fall through is due to the presence of the default spacetime at the core of earth. The same applies to other planet and this is the reason why objects are attracted to the center and proves the fact that only the default nature of spacetime existed. When an object on the surface of a planet is attracted, once it gets inside

the planet, it falls through the stretched spacetime to the center, this is a way of the stretched spacetime indicating that the original spacetime is around leading the object to it. Therefore, during planet formation at the point of creation of the universe, it could be there was a hot fluid around the core of planets that refused to solidify to form an empty space. Hence, the stretching of the default spacetime inside a planet due to line of pressure is done in a way that the default nature around the center of the planet will be untouched. Figure 5 and Figure 6 shows an illustration.

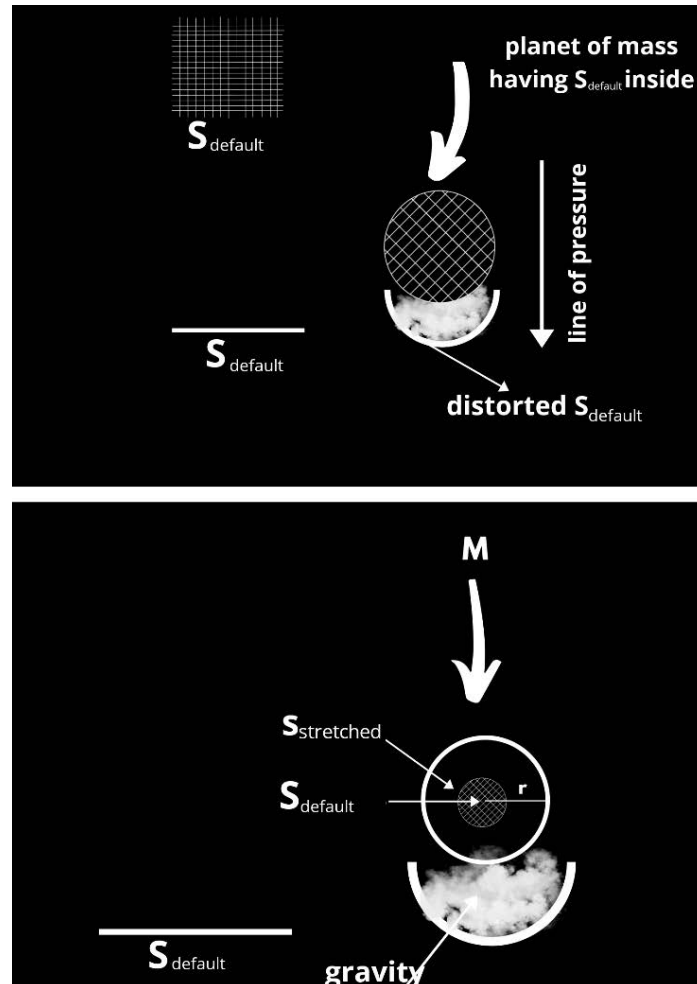


Figure 5



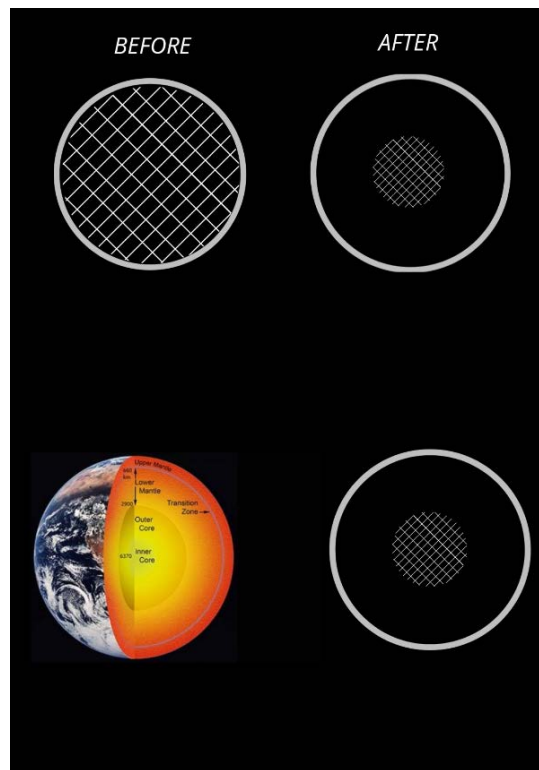


Figure 6

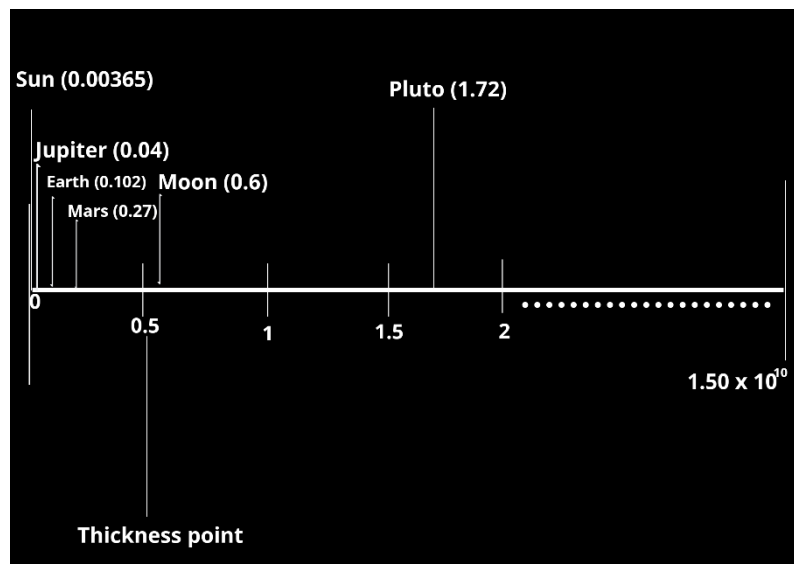


Figure 7

The mass of a planet will determine the pressure that'll be applied. As shown in Figure 7, the Sun and Jupiter are bigger masses than earth and mars. Also, earth and mars are also bigger masses than the moon andpluto. Figure 7 shows the difference between the nature of spacetime in different planets. The nature of spacetime decreases as the mass increases. An object inside a planet will start feeling slight thickness from a spacetime nature of 0.5. The thickness increases as the value increases from 0.5. The expansion of the universe has been proven from observations, therefore

the current nature of spacetime at the outer space is not the default nature but its value is not reduced far from  $1.50 \times 10^{10}$ . Hence, its value still describes a nature of spacetime thick enough to hold the planets from falling. The values of the nature of space for planets in our solar system is shown in [16].

A question can be asked this way; If the effect of gravity stretches the spacetime towards the line of pressure. Why doesn't the effect of gravity keep stretching the spacetime inside rotating planets on the outer space. The answer to this question will bring about

an understanding in quantum gravity. Thus, if we call the gravitational effect that comes from the default spacetime, a default gravitational effect. This default gravitational effect can only stretch the default spacetime. Since the default spacetime initially inside the planets has been stretched to a new nature, a corresponding gravitational effect similar to the new nature will only be authorized to stretch the new nature. This means, no matter how free the nature of space is, just like earth, an object in free fall can cause a distortion on the slightest little particle of spacetime which will bring about a slight gravitational effect (Quantum Gravity). The gravity sequence continues.

### III. EXPANSION OF THE UNIVERSE

The expansion of the universe is the increase in distance between any two given parts of the observable universe with time. Spacetime is the geometry of the universe. Expansion of the universe means "Expansion of spacetime" and expansion of spacetime is the stretching of spacetime. In this new concept, the two causes of the stretching of spacetime were presented. One of the causes have been discussed, its problem has been eliminated by getting the value of the default nature of spacetime before cosmic inflation.

The acceleration/expansion of the universe was discovered in 1998 by the supernovae cosmology project and the High-z supernovae search team, both with the use of type Ia supernovae to measure the acceleration[7,23].

The method in this project involved a type Ia supernovae with the brightness of a standard candle. This kind of supernova is an explosion of an old compact star like the sun, it emits light as a whole galaxy. As objects go further away, they appear dimmer, we can now use the observed brightness to measure the distances. Nobel laureates Saul Perlmutter and Adam Riess of the U.S and Brian Schmidt of Australia contributed to the discovery that the universe is expanding and speeding up. With the help of the best telescopes in the world, their team found over 40 distant supernovae whose light was weaker than expected indicating that the expansion of the universe was accelerating.

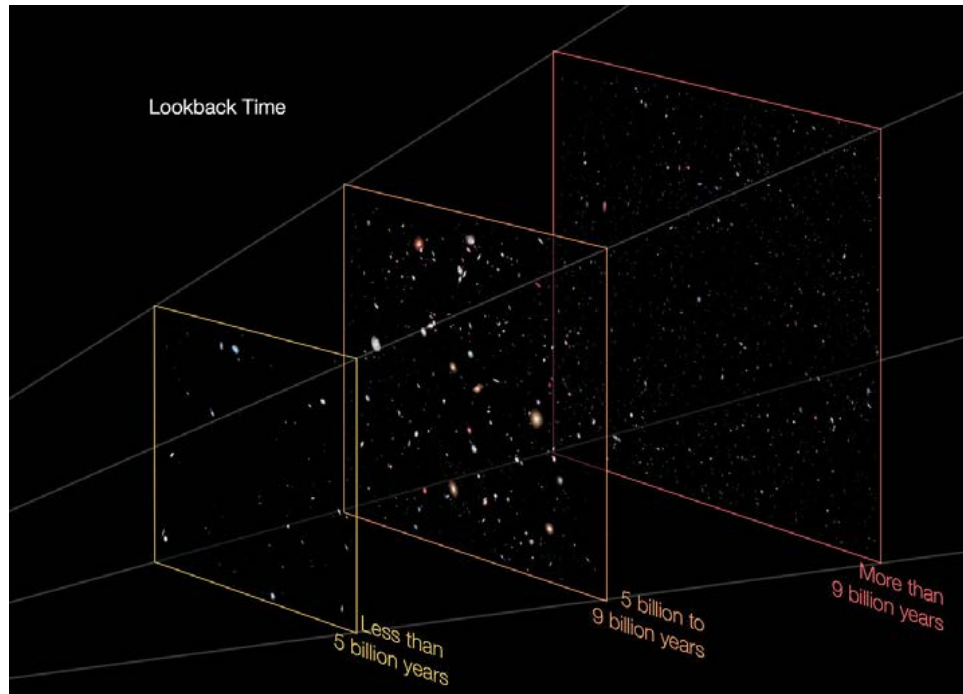
You could take the brightness of a supernova as an indicator of how far away it is; the fainter it is, the further away it is from us and hence its light has taken more time to reach us. So, with the fainter supernovae, you are looking farther and farther back in time. You can also use the colors of the spectral features of a supernova; a supernova would look blue if it were seen nearby, but when you see it very far away, it looks red. How red it gets tells you how much the Universe has stretched since the supernova exploded, because while the light is travelling to us, its wavelength stretches by the exact same proportion as the Universe stretches

(Saul Perlmutter. Nobel Lecture. Rev. Mod. Phys. 88,1127 2012)[24].

Major review points from the discovery project from [7,23];

- 1) Objects in the universe are moving away from one another at an accelerated rate
- 2) The accelerated expansion of the universe is thought to have begun since the early stage of the universe.
- 3) With GTR, an accelerated expansion can be accounted for by a positive value of the cosmological constant, equivalent to the presence of a positive vacuum energy known as dark energy.
- 4) The finding has led to the now widely accepted theory of dark energy. Our finding that the universe was presently accelerating, immediately suggested a profound conclusion. The Universe's cosmic energy budget is dominated by a type of smooth distributed "dark energy" (Adam.G.Riess. Nobel Lecture. Rev. Mod. Phys. 84,1165)[1].

## a) Major Evidence of the Expansion of the universe



**Figure 8:** Hubble eXtreme Deep Field, the photo was assembled by combining NASA/ESA Hubble Space Telescope observations taken of a patch of sky within the original Hubble Ultra Deep Field

One of the major evidences of the expansion of the universe is the galaxy clusters decrease in density[25]. Figure 8 shows the decrease in cluster density from less than 5 billion years to more than 9 billion years. This is a prove that spacetime is also losing its thickness as it expands. If more space of the same nature would magically appear, it wouldn't have to affect the density of galaxy clusters rather it will add to the increase in area of the universe. The only way the density of galaxy cluster will be affected is if the spacetime around them stretches (expands) which will also result in reduction in thickness to enable the bodies to move apart.

From these observations and experiments, the other cause (dark energy) of the stretching of spacetime has been proven. As an attempt to reveal the nature of dark energy, a neglection in the discovery of EMR must be fixed.

#### IV. ELECTROMAGNETIC RADIATION

The nature of dark energy has become a very important question in physics. Dark energy might be a lot different from normal energy (EMR). Why do we know the nature of normal energy and not dark energy? Could dark energy be the same as normal energy but an unseen version. In this new concept, there's a clue which is the fact that dark energy is a property of spacetime. From observations and theoretical concept, it is a positive energy.

For the nature of dark energy to be discovered in this new concept, the details of EMR must be reviewed deeply.

In physics, electromagnetic radiation (EMR) refers to the waves (photons) of the electromagnetic field, propagating through space. It includes radio waves, infrared, visible light, microwaves, ultraviolet, X-rays, and gamma.

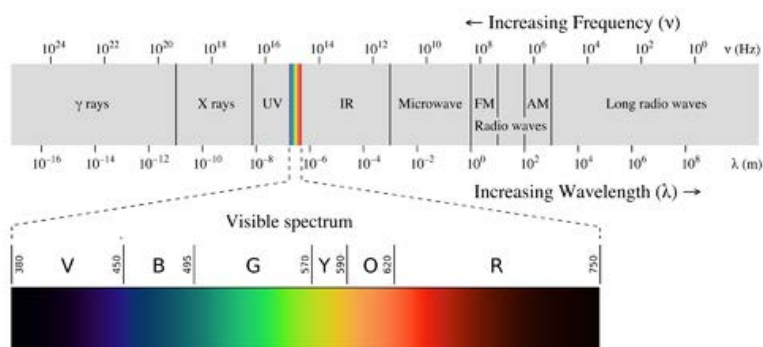


Figure 9: Is an electromagnetic spectrum indicating all types of EM waves characterizing them by their frequency and wavelength

Electromagnetic radiation consists of electromagnetic waves, which are synchronized oscillations of electric and magnetic.

Electromagnetic waves do travel at the speed of light ( $c$ ). The position of an electromagnetic wave within the electromagnetic spectrum can be characterized by either its frequency of oscillation or its wavelength. In quantum mechanics, an alternative way of viewing EMR is that it consists of photons. The energy of an individual photon is quantized and is greater for photons of higher frequency. This relationship is given by Planck's equation  $E=h\nu$  where  $E$  is the energy per photon,  $\nu$  is the frequency of the photon and  $h$  is Planck's constant.

There can be other sources of the waves of EMR, but the natural source is from the stars. In this paper, to discover the nature of dark energy, the stars as the source of EMR is the description. Therefore, the term "EMR" or "EM radiation" further mentioned in this paper is defined as the whole energy picture from a star as figure 10 shows

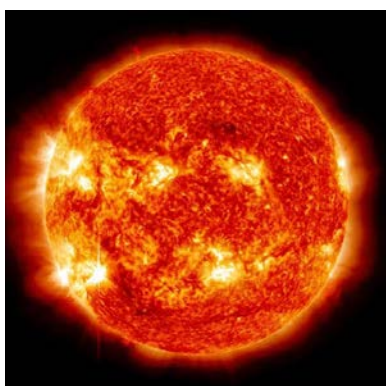


Figure 10

Planets in different solar systems rotate around their star. These stars are the source of light to their planets. However, these planets have a layer that do absorb harmful rays from their star. This layer called the ozone layer was discovered in 1913 by French Physicists Henri Buisson and Charles Fabry. The ozone layer found in the region of stratosphere contains high

concentration of ozone ( $O_3$ ). The average ozone concentration in Earth's atmosphere as a whole is about 0.3 parts per million. Measurements showed that with the presence of the ozone layer, there was no radiation below a wavelength of about 310nm at the ultraviolet end of the spectrum.

The ozone layer absorbs 97 to 99 percent of the Sun's medium frequency ultraviolet light (from about 200nm to 310nm wavelength) which otherwise would damage exposed life.

The thickness of the ozone layer varies. It can be thinner near the equator and thicker at other parts of the planet.

EMR from the stars are the closest to dark energy because they are the only natural source of energy existing. At the outer space where the effect of dark energy is observed is the same environment where the death of a star happens.

Major points from observations of EMR[5].

- 1) Electromagnetic waves do travel at the speed of light
- 2) The position of an electromagnetic wave within the electromagnetic spectrum can be characterized by either its frequency or its wavelength.
- 3) Relationship between energy per photon and its frequency is given by  $E=h\nu$ .

It is known that EM radiation propagate/move in particles (photons) as illustrated in figure 11

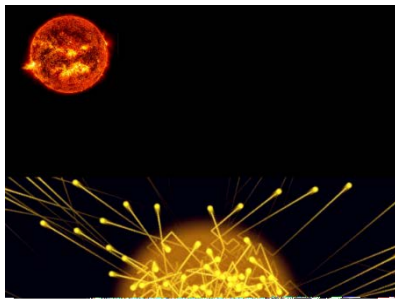


Figure 11

Using the sun (star) as an example for this explanation; radiation from the sun is known as sunlight, it is a mixture of electromagnetic waves. EM waves or rays ranging from gamma to radio waves of spectrum are produced by the sun, these rays are characterized by their frequency. For example; Gamma rays are produced from fusion at the core, getting to the surface of the sun, they are absorbed by the solar plasma and re-emitted to lower frequencies. Reaching the surface of the earth, the frequency will be within the range of infrared to UV in the spectrum. Therefore, a photon from a sun making its journey to the surface of the earth can be a gamma ray photon or an ultraviolet ray photon or the nature of any rays of the spectrum but there's a relationship between quantum mechanics and classical mechanics. To a dinosaur, humans appear like ants. To ants, humans appear like dinosaurs. This relationship with both mechanics is the fact that the whole energy picture of the sun is a photon at a macroscopic view. The sun can emit different types of photon of the EM spectrum, but it can often emit a photon that represents its nature comprising of the whole EM rays.

#### a) Pack Photons

In this concept, as related to the stars, a term called "Pack Photons" is introduced, the reason for this is demonstrated with figure 12

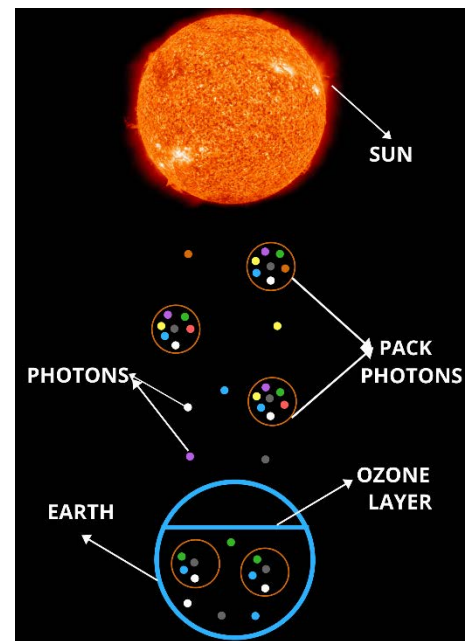


Figure 12

A pack photon represents the whole energy picture of a star in quantum form. Remember, stars consist of a mixture of all EM rays and can emit photons of different rays but can often emit photons that represents itself. Thus, a pack photon consists of sub-particles of all EM rays. From figure 12, it is seen that the UV photon (purple), Infrared photon (green), X-ray photon (red), Gamma ray photon (yellow), radio wave photon (blue) microwave photon (black) and visible light photon (white) can all find their way to the earth's surface but there exist a photon that contains all, it is been emitted often.

From figure 12, it is seen that the UV particle light and other harmful particles disappears after the pack photon has crossed the ozone layer. The ozone layer simply filters the harmful sub-particles from the pack photon.

Figure 12 also shows the release of pack photons from the sun which is a star. Each of these pack photons contains sub-particles of each rays of the electromagnetic spectrum. The idea behind this pack photons is backed up with the measurement of the fine structure constant. The fine structure constant  $\alpha$ , is a dimensional constant that characterizes the strength of the electromagnetic interaction between charged particles. It also describes the tendency of an electron to absorb a photon.

Providing a clue to an experimental prove of this new theoretical concept of EMR will be done mathematically

The energy of a photon is given as E

Electromagnetic waves move with the speed of light (c)

The relationship between an energy of a photon (E) and its frequency (f) is (h)



The medium through which the photons propagate is defined with (k)

Speed of light (c) =  $3 \times 10^8 \text{ m/s}$

Planck constant (h) =  $6.582 \times 10^{-16} \text{ eV.s}$

Coulomb constant (k) =  $8.9 \times 10^9 \text{ N.m}^2.\text{C}^{-2}$

In this new concept, the energy of a pack photon is given as  $E_{\text{packphoton}} = k/hc$

$$E_{\text{packphoton}} = 4.5 \times 10^{16} \text{ J}$$

Thus, the energy of a pack photon is given as  $4.5 \times 10^{16} \text{ J}$ . Before initiating the idea of a pack photon, this value was found to also have a meaning in quantum mechanics in this way, the value of a pack photon together with the value of the charge of an electron or elementary charge ( $1.60 \times 10^{-19} \text{ C}$ ) gives the exact or approximate value of the measurement of the fine structure constant i.e  $4.5 \times 10^{16} \times 1.60 \times 10^{-19} = 0.0072$ .

The fine structure constant  $\alpha$ , is a dimensional constant that characterizes the strength of electromagnetic interaction between charged elementary particles, a precise determination of  $\alpha$  allows for a test of the standard Model of particle physics.

Parker et al used matter-wave interferometry with a cloud of cesium atoms to make the most accurate measurement of  $\alpha$  to date.

Using the recoil frequency of cesium-133 atoms in a matter-wave interferometer, we recorded the most accurate measurement of the fine structure constant to date:  $\alpha = 1/137.035990046(27)$  at  $2.0 \times 10^{-10}$  accuracy. (Richard.H.Parker et al. Measurement of the fine structure constant as a test of the Model 2018 Vol. 360 Issue 6385, pp 191-195)[22].

The confirmation of the value of a pack photon has not been done experimentally. A photometer is an instrument that measures the strength of electromagnetic radiation in the range from ultraviolet to infrared. An advanced photometer can be used to confirm this value but can only be done at the outer space or the surface of the earth above the ozone layer. There's not a complete pack photon on earth except one manage to escape through the ozone layer.

However, this energy of a pack photon might just lead us to dark energy.

*Note:* In this paper, when the term EM radiation or EMR is mentioned, it is referred to as a higher (classical) form of a pack photon i.e the whole energy picture from the sun (star).

## V. DARK ENERGY

In cosmology, dark energy is described as an unknown form of energy that affects the universe on a large scale.

The major evidence of dark energy's existence was through the expansion of the universe discovered from supernovae measurement.

It is known that dark energy contributes 68% of the total observable energy in the universe.

Dark Energy is thought to be very homogenous and not very dense and is known to interact through any of the fundamental forces other than gravity.

Dark energy was discovered in 1998 by two teams of astronomers who measured light coming from exploding stars. The striking result was that distant supernovae were dimmer than they would be in a universe that was slowing down. It was thought that dark energy was the cause of an accelerated universe. This acceleration is thought to have begun about 5 billion years ago. Although the first discovery of the effect of dark energy was in 1929 by Edwin Hubble when he noticed that the further a galaxy is from the earth, the faster it is moving away from us.

Major concluding points from the discovery of dark energy[1,6,7,23,24,25,27];

- 1) It is a positive vacuum energy.
- 2) Dark energy causes the expansion (stretching) of space which is also the expansion of the universe.

In this paper, to reveal the nature of dark energy, a modified concept of the creation of the universe (Big bang) must be presented. Earlier in this paper, we discovered mathematically the value of the default nature of spacetime (the thickest form).

Matter is in one way or the other, a form of radiation (EMR). Matter and Energy(Radiation) are two forms of the same thing with Einstein famous equation ( $E=Mc^2$ ).

This concept provides a mathematical prove of the relationship between spacetime and dark energy with the relation. If dark energy is presented as  $E_d$  and the value of the default nature of spacetime from Section 2.0 is  $S_{\text{default}} = 1.50 \times 10^{10}$ . Thus, one thing is certain, dark energy must move with the speed of light (c). With the relation  $E_d = S \times c$

The value of dark energy as related to the default spacetime before cosmic inflation  $4.5 \times 10^{18}$  as a constant.

There's a term called black hole evaporation. This describes the fact that black holes that do not gain mass through other means are expected to shrink and alternatively vanish. The bottom line is that all black holes do vanish and where do their radiation or burst go?

In standard cosmology, there are four entities that makes up the universe, they are energy (radiation), matter, dark matter, dark energy. A star is in possession of EMR in full scale, the death of a star leads to a black hole on spacetime producing Hawking radiation[8]. The whole concept of black hole evaporation/Hawking radiation is a prediction without observational/verified proof. It can only be observed that black holes evaporate after some time, but conclusions have not been made as to what causes the evaporation.

Let's face the reality, radiations (EMR) from black holes do not vanish in space just like that unless it is regarded as magical. There exists a reason why a death star will tear spacetime to create a black hole, which will be understood at the end of this section.

With this new concept, I choose to educate the world on the big bang of the universe. The Scientific and Physics environment and every other person must follow the reality that dark energy and radiation (EMR) were the same thing at some point at the creation of the universe and these two together form a major light which set-up the creation.

The combination of these two (dark energy and energy) can be termed "Omni" – The highest energy form but it is simply energy (EM radiation) taking the form of dark energy. Dark energy is superior to EM radiation from their values. Thus, if these two are combined, EM radiation takes the form of dark energy and they both exist as one light. Otherwise, if these two are split, EM radiation takes its own form and dark energy remains as its. Hence, when a black hole is formed and vanishes later, its radiation goes back to form one body with dark energy as "Omni" – the light used during the big bang. Although this is done in space, dark energy and space cannot be seen but its effects can be observed or felt resulting into the fact that

human eyes or observations can't see the re-uniting of EM radiation back to dark energy through black holes rather we can only feel or observe a radiation that just vanishes in space (Black hole evaporation).

However, dark energy is the energy fluid of spacetime. Hence, if dark energy and spacetime are one body, then it means that spacetime, dark energy and energy (radiation) were one body at the point of the big bang. These are the three entities used in the creation of the universe.

The explanation behind Albert Einstein's famous equation ( $E = mc^2$ ) is the fact the solidification of EM radiation formed the planets which is a classical state of matter. If all matter in this universe are traced to their natural source, it will result to EM radiation. This makes matter and EM radiation two forms of the same thing. Dark matter is a form of matter that is known to not interact with light just like dark energy. There is no doubt that dark matter and dark energy are also two forms of the same thing, dark energy and EM radiation were also the same thing at a point during the creation of the universe. Since dark energy is superior to EM radiation, the question of how the big bang happened sums up to one thing; the creation of the universe was done with spacetime and its energy fluid (dark energy).

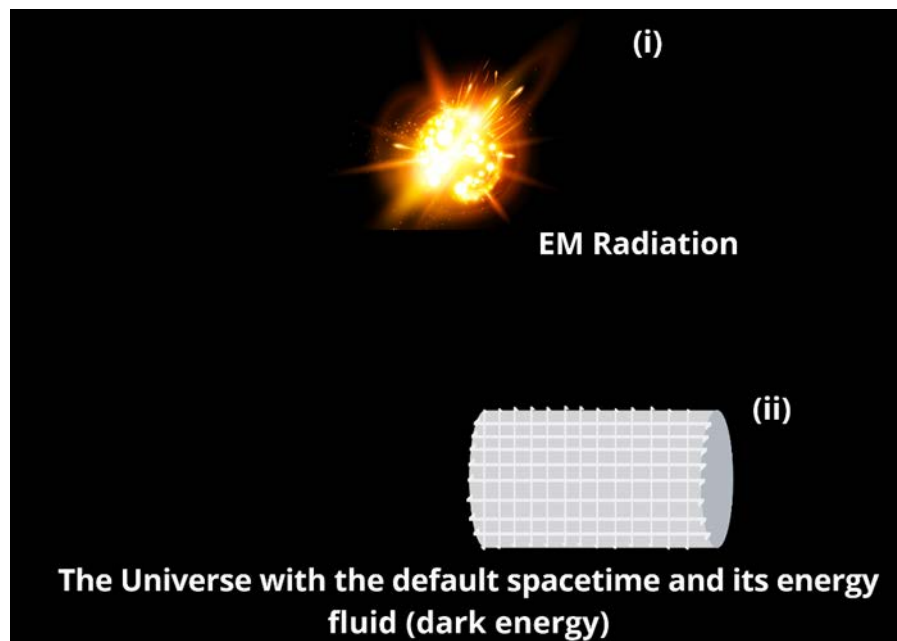


Figure 13

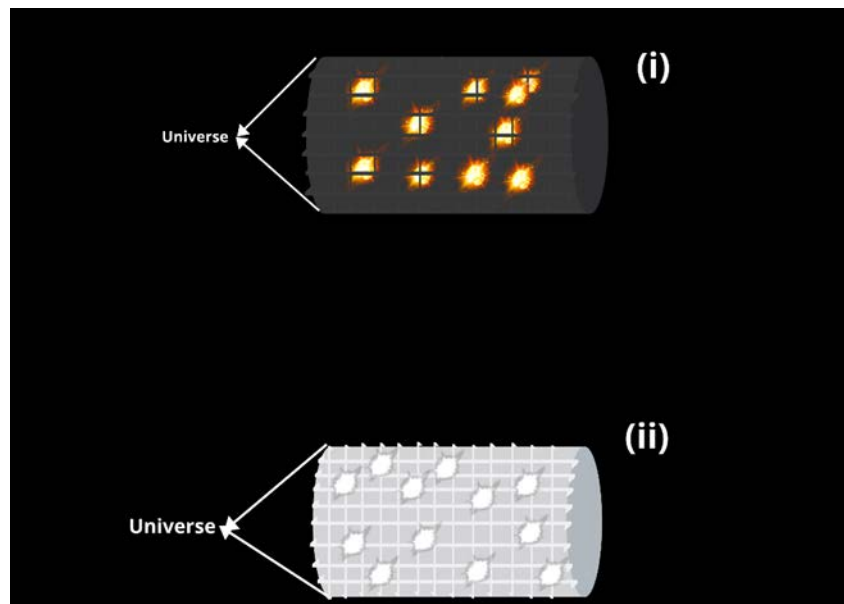


Figure 14

During the creation of the universe, spacetime was used everywhere as the entire geometry and structure of the universe, i.e. the universe itself is the default spacetime along with its energy fluid just like (ii) in Figure 13, this also implies that dark energy was also everywhere. The solidification of EM radiation formed all planetary body we see at the outer space. However, 13 billion years ago at the point of creation, although these bodies were formed with EM radiation, if a human existed then, he/she would not see or observe these bodies as EM radiation or a form of EM radiation, rather he/she will observe these bodies as dark energy or a form of dark energy.

Using (i) in Figure 13 as EM radiation and (ii) in Figure 13 as the universe with the default spacetime and its energy fluid. In Figure 14, (ii) explains the situation at the creation of the universe. Although there were EM radiations and forms of EM radiation, they didn't exist as EM radiation rather they existed as dark energy or forms of dark energy. This reason is because dark energy is superior to EM radiation and both entities were merged at the point of creation. The things made from EM radiation (matter) have a property of fading after a certain period and on the other hand, dark energy has an opposite property to that. Although, at the creation of the universe, an explosion was done with EM radiation in an environment of spacetime and dark energy, to ensure a universe where things will not have to fade, EM radiation has to take the form of dark energy due its unique property of being unable to fade.

Everything that involves matter and the way it behaves is Physics, but some things do happen that we consider as magic simply because we don't see what happens on the other side. 50% of physics involving matter has only being studied, the other 50% of physics that involves the unseen is yet to be studied. It's simple,

dark energy is not invisible or unknown, one of the brothers is no longer in unity with the other, proceeding to create a whole new dimension that is not dark energy dimension as described in (i), Figure 14. One dimension existed at the point of creation (dark energy dimension). Since the splitting created a new dimension, the superior dimension (dark energy) will be invisible to EM radiation dimension. Therefore all things matter will not be able to see and observe the other. In (i) (Figure 14), it is seen that a dimension of EM radiation has been formed and it no longer takes the form of dark energy as (ii) (Figure 14) shows, resulting into dark energy dimension being invisible. Thus, EM radiation and its forms will not be able to see, observe or interact with dark energy. Furthermore, it is spacetime that leads any free EM radiation back to dark energy through the help of a black hole. Dark energy is not meant to stretch or expand spacetime (universe). This is just like the statement; Spacetime separates both dimensions, "Dark energy lost his twin brother long ago and is in search for all of it", thereby stretching spacetime as an attempt to reunite with it. On the other hand, EMR from a death star tears spacetime at one end as an attempt to re-unite with dark energy, signifying the fact that energy cannot be destroyed. As long as dark energy doesn't reunite with all of its lost twin brother, dark energy will continue to stretch the nature of spacetime at the outer space until it eventually gets to a nature of spacetime like the one on earth and we all know what that means. Planets will crash with one other, the EM radiation from stars will consume several planets, this is exactly how the universe will end. The existing EM radiation from stars will consume planets thereby increasing its mass, when all existing matter are consumed by the existing EM radiations, the universe will be left with just EM radiation, i.e. just like the EM radiations exploded long

ago, scattering at different places, they'll all come back together this time. However, what caused the splitting of EM radiation from dark energy is biblically revealed to be as result of a mistake from the first man.

This theoretically concept of dark energy is the result from the similarity between the value of a pack photon and dark energy of a default spacetime. The presence of 4.5 in both values represents the fact that EM radiation can always reunite with dark energy. i.e take the form of dark energy but presently both entities differ by 100.

Hence, this concept has been proven mathematically and theoretically. Experimentally, the value of dark energy will be difficult to prove. However, if the energy value of a pack photon can be measured exactly as  $(4.5 \times 10^{16} \text{J})$ , then this theoretical concept will just be complete and approved. (i) in Figure 14 represents an unstable universe while (ii) in Figure 14 represents a stable universe.

## VI. CONCLUSION

In standard cosmology, the universe is made up of Energy (radiation), matter, dark energy, and dark matter. Albert Einstein made it clear that matter and energy (radiation) are two forms of the same thing ( $E=Mc^2$ ) [12]. With the new concept in this paper, dark energy and energy (radiation) where one body during the big bang. Hence, dark energy and dark matter are two forms of the same thing illustrated in Figure 15. With the help of ( $E=Mc^2$ ), if the value of dark energy is  $(4.5 \times 10^{18})$ , replacing matter and energy with dark matter and dark energy with the equation ( $E=Mc^2$ ), the resulting value of dark matter will be "50". The description of this number as dark matter is not yet clear but the value "50" (100/2) signifies that there are two dimensions in the universe presently, a dimension of dark matter and dark energy and a dimension of matter and energy (radiation).

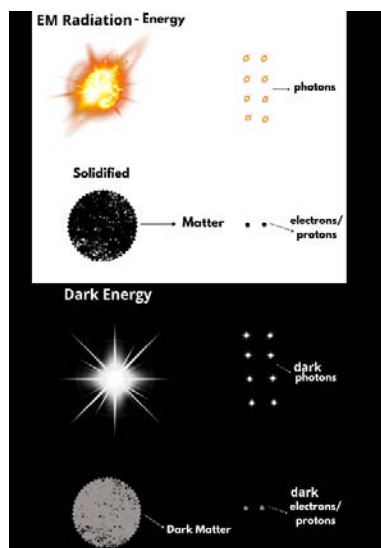


Figure 15

There are hidden answers in the puzzle of this universe, calculations in physics can help us get those answers which I demonstrated in this paper. Thus, physics and cosmology a wait experimental prove of all the new concepts proposed in this paper.

## ACKNOWLEDGEMENT

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