Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 17 February 2021 doi:10.20944/preprints202102.0371.v1

Review Text:

Gravity, where does it come from?

Ahmed Isam

Independent Researcher.

Khartoum, Sudan. Email: ahmedisam777@gmail.com

Keywords:

Theory of Relativity, Gravitational Field, String Theory, Light Medium, Rest Motion.

Abstract:

Einstein's theory of general relativity describes the gravitational field around massive objects (like Earth) as a curvature in the spacetime. But it leaves the following question unanswered; why is the spacetime curved by a mass? Through a theory that has been introduced recently, regarding a medium for a light propagation, a simple answer is introduced. It depends on redefining the rest energy for a massive object (like a planet) as new form of kinetic energy. For a static and spherically symmetric object, with a specific radius(r_o), I have found that this kinetic energy is $\frac{r_0 c^2 v_0^2}{2G} = Mc^2$, where ($M$) is the object's mass, and (v_o) is a new term defined as rest speed of this object. The value of this rest speed determines the curvature of spacetime around the object. The results which are obtained are similar to Schwarzschild solution of Einstein's field equations.

Introduction

The General Theory of Relativity describes the gravitational field around a massive object (like Earth) as a curvature in the spacetime fabric around its surface [1][2]. All the classical effects of gravity from an apple that falls from a tree, up to light rays from a distant star that are bent by the Sun are justified by this notion; spacetime curvature. But from a classical perspective, I believe the following question is important; *why does a massive object curve the spacetime*? Or in a general form; Where does gravity come from? In this paper I introduce an approach to answer this question. But first I have to introduce two more questions; *What is light? Where do matter waves come from?* Initially, these two questions may appear irrelevant to our subject in this paper. But surprisingly, the approach that I have used to justify the existence of gravity mainly depends on answering these two questions. Therefore, I shall start by introducing a brief answers to these two questions. Recently, I have introduced a new medium for light propagation in the universe. The new version is called Sama aether theory (SAT) [3][4]. Regarding aether (*ether*) as a medium for light propagation, there are two facts that should be mentioned. The first is that many physicists believe that light or electromagnetic (EM) waves do not need a medium to propagate from one place to another. Therefore, the notion of ether as a medium for light propagation is considered to be an "*unnecessary*" idea. The second fact is that the concept of light's medium has become experimentally problematic, since Michelson-Morely experiment [5]. For the sake of honesty, I partially agree on these facts, but I also believe that the quest for the ether as a medium for light propagation is not interesting by itself. But the major goal behind SAT is not to introduce a medium for light propagation in spacetime, *although it is spontaneously achieved in the theory*. The major goal is to introduce a better understanding for some basic phenomena that constitute the base of modern physics, including the existence of gravity.

As we have mentioned, SAT depends on two simple postulates [3][4]. The first postulate of SAT states that ***the ether has multiple, equivalent rest frames***. To explain this, an observer is said to be in a rest frame with respect to ether, when the velocity between him and the ether is classically equals to zero. Therefore, it represents an inertial state. Now, since the observer is existed in a rest frame with respect to ether, any light signal will propagates with the same speed (c) in all spatial directions **Figure 1** as:

$$|\vec{c}_x| = |\vec{c}_y| = |\vec{c}_z| = c$$

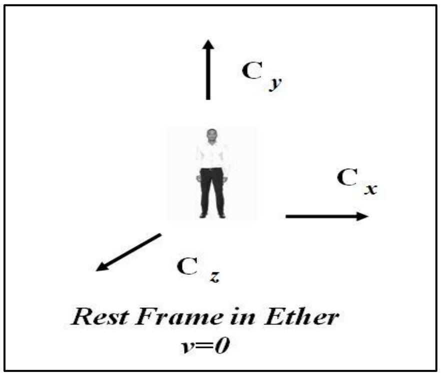

Figure 1. *When the velocity between the observer and the ether equals zero, the observer is said to be in rest frame with respect to ether. Therefore, light will propagate in all directions with the same speed (c).*

In the classical picture of ether that was existed in the 19th century, the previous observer can simply leave the rest frame by acceleration, then he will be in motion with respect to ether, and this can be detected by the differences in the speed of light propagation according to the observer's velocity with respect to ether. When the observer is moving in the same direction of light propagation, the speed of light will be reduced by $c'=c-v$, and it will be increased, if the observer is moving in the opposite direction as $c'=c+v$. Many experiments were performed to detect this effect (motion with respect to ether). The famous one is Michelson-Morley experiment. But it failed to detect any motion with respect to ether, and its failure was considered to be a major contradiction with the notion of ether.

If we shift to our ether model (SAT), ***existence of multiple equivalent rest frames in ether*** simply means this; by saying "***multiple***" *this* means that there is ***more*** than one rest frame in ether. Therefore, any observer can leave one rest frame, and gets into another. In other words, the ability of different observers to occupy different rest frames in the same medium or ether. Also, by saying *"**equivalent**"* this means that all the rest frames in ether are physically the same. There is ***no*** any difference between them. From here, there will be no physical experiment that can differentiate one rest frame from another. As a result of this, all physical experiments will give identical results in all rest frames. Let us take the following example for illustration. Assume the existence of two observers, observers (1) and (2) in a specific rest frame (A) as illustrated in (**Figure 2-a**). Now, assume that observer (2) has the desire to leave rest frame (A) and gets into another rest frame. As explained earlier, the only way that observer (2) can escape the rest frame is by applying a force on him. In this situation, he will be accelerating with respect to observer (1), (**Figure 2-b**).

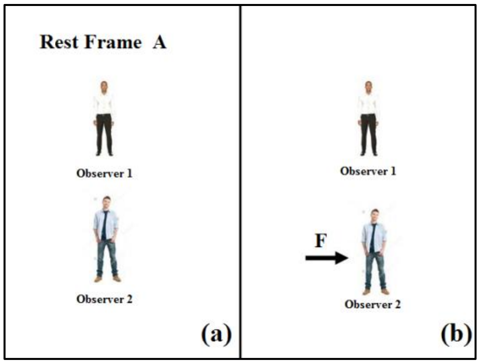

Figure 2. *(**a**) Both observers located in the same rest frame (A). (**b**) Observer (2) leaves the rest frame by the acting force of magnitude (F)*

According to the observer's (1) prospect, observer (2) can only be in three different states with respect to him. The first, being in his rest frame (A). The second is moving with a constant velocity. The third is acceleration. Any rest frame represents inertial frame (no force), as explained earlier. Therefore, if there is another rest frame in ether, other than (A), it should appear as a constant motion with respect to observer (1). Because it is the only inertial state that is remaining. From here, if observer (2) wants to occupy a rest frame once again in ether, he simply has to stop the force that acting on him (stop acceleration). In this situation, he will be moving with a constant velocity ($\mathbf{v}_x$) with respect to observer (1) **Figure 3**.

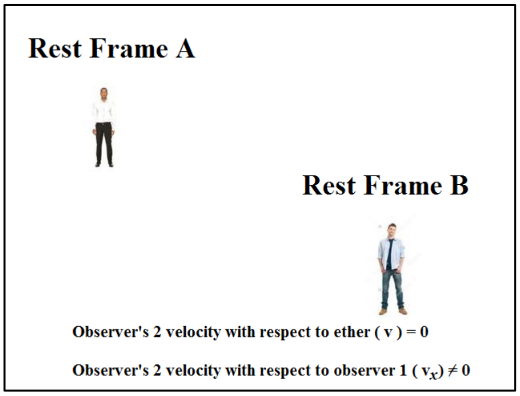

Figure 3. *Observer (2) occupies a different rest frame in ether (B), which means the velocity between him and ether is zero, but in the same time the speed (v_x) between him and observer (1) is more than zero.*

Now, observer (2) occupies a rest frame with respect to ether, which means that the velocity between him and the ether is zero. Although, he is moving with respect to the other observer with a constant velocity ($\mathbf{v}_x$). Let us call this new rest frame (B), and it differs from the rest frame (A) which is occupied by observer (1), because observer (2) is moving with a constant speed with respect to him. Experimentally, both observers can detect their states with respect to ether by sending a light signal in all spatial directions. The signal will propagate in all spatial directions (*x*

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 17 February 2021 doi:10.20944/preprints202102.0371.v1

,y ,z) with the same speed, which means that both observers are in rest frames with respect to ether, regardless the constant speed (v_x) between them **Figure 4.** Furthermore, since the two rest frames are physically equivalent, there will be no physical experiment that can differentiate rest frame (A) from rest frame (B). As result of this, all physical experiments will give identical results in both rest frames, if they are performed under similar physical conditions. In other words, this means that the laws of physics will be the same in both rest frames.

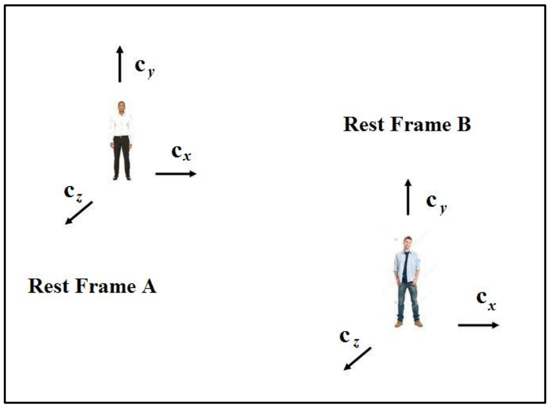

Figure 4. *Two equivalent rest frames in ether*

The new ether model represents ***multi-rest frames*** medium that contains ***more*** than one rest frame. From this perspective, the old traditional ether model is a uni-rest frame medium. The main difference between the two models is that motion with respect to ether is detectable in the old traditional ether as differences in the speed of light propagation, according to observer's movement. But in the new model, it is not detectable, due to multiplicity of rest frames in its entity. However, accelerating frames are not rest frames in ether, but still, the speed of light will remain the same. The justification for this point will be discussed later, when gravity is considered. From our previous discussion, the consequences regarding our first postulate of ether are simply the same consequences, regarding the constancy of the speed of light propagation, and the equivalence of physical laws in all rest frames (inertial frames) in ether. These two consequences are not new. We are familiar with them from Einstein's special theory of relativity (STR). They are the two postulates that STR is built on. But here, in our ether theory, they are not postulates, but they are consequences or results to our first postulate in ether. Therefore, we can say that the two postulate of STR are just reflections to our first postulate of SAT.

The second postulate of SAT implies that ***the kinetic energy, and the potential energy are the only forms of energy for the ether's waves*** [3][4]. The kinetic energy and the potential energy are mechanical forms of energy; *they are always carried on particles or quanta*. These quanta have a linear momentum, and acquire energy from their motion. The physical importance of this postulate is that the wave theory in classical physics does not forbid a wave from carrying its energy in the kinetic, and the potential forms, just like sound waves or all other mechanical waves. A major difference between the EM waves and the mechanical waves is the amplitude of the wave. The mechanical waves just like the sound wave, there are two velocity vectors **Figure 5.** The first is associated with the amplitude of the wave, and the second is the propagation velocity vector. The particles which carry the energy of the sound waves move according to the amplitude's velocity vector. This is by itself results in a roughly continuous distribution of energy along the wave front. On the other hand, the amplitude in the EM waves (ether's waves) is a field that is not related to a mechanical entity as in the mechanical waves; it lacks motion. The EM wave has only one type of movement, which points toward the direction of wave propagation. Therefore, the quanta (particles) which carry the wave's energy will have only one possible direction of movement, which is the direction of wave's propagation. Hence, light propagates as a wave, but if we try to detect its energy experimentally, it will be detected in discrete, localized spots (quanta), ***and not continuously along the wave front***. From this aspect, the radiation of EM waves can be visualized as a beam of quanta that move with the same direction of wave propagation.

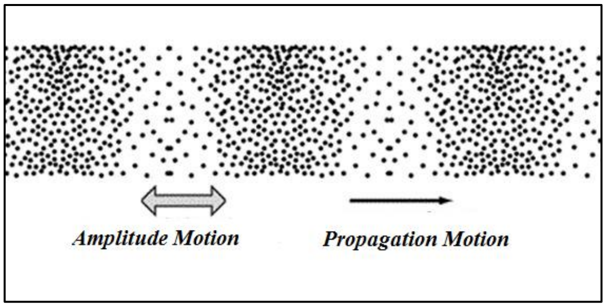

Figure 5. *Sound waves in air. There are two types of motions in any mechanical wave. The amplitude motion and the propagation motion.*

The second postulate of SAT is best understood as a reflection of a deeper reality that exists in nature. This reality arises from a fact that the energy in nature has a limited number of forms or types. The electric (magnetic) field represents a physical entity that spreads continuously in spacetime. This field carries energy, but what type or form of energy? I think this is the important question that should be asked. Since energy comes in a number of forms, the classical physicists simply assumed that the electric field has its own form or type of energy, which can be called the electric field form of energy. For a charged particle like an electron, the electric form of energy was assumed to spread continuously with the field itself. From here, when this field propagates as EM wave, the energy will spread continuously along the wave front. Unexpectedly, this contradicted the experimental findings which indicate that the energy of the EM wave is detected in discrete, localized spots. As a result of this, I think we are enforced to say that; *the EM field lacks its own form of energy*. But instead of this, it carries the kinetic form of energy (which means on quanta) , although the field itself spreads continuously in space. Consequently, light can be defined as a wave that carries kinetic energy*; it seems that there will be no need to assume that light has a dual nature*. Because, the wave theory by itself does not forbid a wave from carrying its energy in the kinetic form, just like saying sound wave is a wave that carries kinetic energy. But the difference between light waves (field waves), and sound waves (mechanical waves), as we have discussed is that the latter have two types of motion**,** which results in a rough continuous distribution of energy along the wave front **Figure5**. By using a simple classical calculations, we were able to derive the formula $E = hv$, and to predict the existence of Planck's constant from the same classical calculations[3].

The framework of our theory requires that the EM waves not to be the only waves in ether [3][4]. This opens the possibility for the existence of other field waves in ether. These field waves share the same medium with the EM waves, but with different amplitude field values. Hence, the second postulate of SAT will be applied on these field waves just like EM waves, since they are wave in ether. The result of this will be just like that of EM waves. The energy of these different field waves will be carried on quanta. We have shown that the value of these different amplitudes can be visualized as "ψ". Where $|\psi|^2$ is simply related to the probability of experimentally detecting the field's quantum in a specific point in space and time. Since ψ is a general value for any field wave. ***This means that different field values with different physical properties will be detected as different particles or quanta with different physical properties***. The problem with this concept is that, these field waves " *matter waves*" carry rest energy E_0 , which contributes to wave's energy , and it is neither kinetic nor potential energy, which violates the second postulate of SAT . But we were able to solve this problem by proving that the kinetic energy has three

 doi:10.20944/preprints202102.0371.v1

different forms in nature as will be discussed in the next section**.** The first is the classical form $KE_1 \approx \frac{1}{2} m_0 v^2$, and the second form is $KE_2 = E = pc$ which represents the energy of a massless particle. The third form of kinetic energy represents the rest energy itself. By talking about a relevant point, in order to build a theory that unifies the physical interactions in one theoretical framework, I think we have to overcome two major problems. The first is that the theory has to provide us with one picture or idea about the universe. In other words, describing the different physical interactions as different reflections of one origin. The second is to overcome the problem of the infinities that arises from the uncertainty principle. String theory [6], overcomes these two problems spontaneously. First, it provides us with the idea of the string which represents the fundamental element in the universe. The basic idea behind this theory is that this string vibrates with different states of vibrations, and each state of vibration corresponds to a different physical particle. From here, the unification of physical interactions becomes prominent, since we have one string, with different states of vibrations that give us different particles, which mediate the interactions that we observe in nature. **Figure 6.**

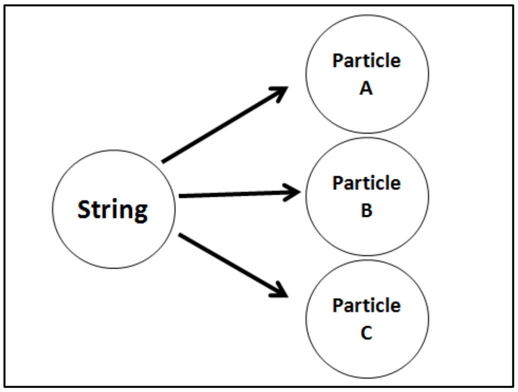

Figure 6. The basic idea in string theory is that, each state of vibration in the string corresponds to different particle, for example a hypothetical state of vibration (A) gives a hypothetical particle (A). A hypothetical state of vibration (B), gives a hypothetical particle (B), and so on.

Furthermore, this string has a one dimensional extension in space-time, which means that the problem of infinities is solved, since it arises from a "*zero"* spatial distances of physical interactions. The problem with this current approach for unification in the string theory is that it describes the gravitational interaction by a particle "***graviton"*** which represents a state of the string itself. This represents a problem because it makes gravity a background-dependent interaction, which represents a major contradiction to the picture of gravity in the GTR. Because GTR describes gravity a curvature in the fabric of space-time which makes gravity a background-***independent*** interaction. From here, if we accept this approach of unification, we will have to undo the picture of gravity that is given by GTR.

In our ether theory SAT, we have a similar approach of unification. Here, we do not have strings, but we have the ether, and as we mentioned in the previous section, the ether has different waves with different values of amplitude. Each amplitude represents a specific field wave in the same ether **Figure(7)**

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 17 February 2021 doi:10.20944/preprints202102.0371.v1

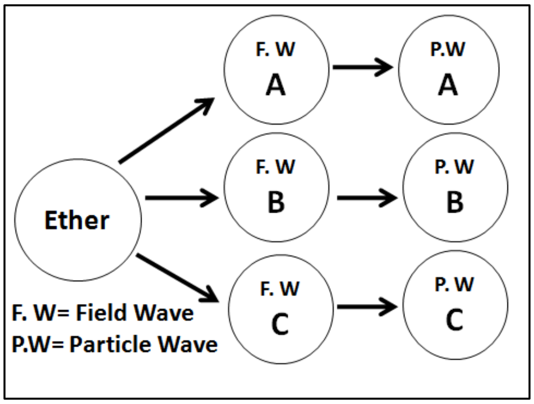

Figure 7. In SAT, The ether has different amplitudes, and each amplitude represents a specific field wave. The hypothetical field wave (A), and the hypothetical field wave (B), will be detected practically as waves of probabilities for particle (A), and particle (B) respectively.

A major difference, from the string theory is that we have used a background-***independent*** approach to include gravity in our theory; *the gravitational field and Spaetime (our background) are the same physical entity, which represents the main idea behind GTR. .*

2- Defining the Concept of the Rest Speed:

We start this section by defining the ordinary kinetic energy for a particle. When a force of value (**F**) is applied on a particle with a rest mass (m_0) , the kinetic energy (*KE*) will represent the work (*W*)which was done by this force, as $KE = W = \int_0^{\vec{s}} \vec{F}.\, d\vec{s} = \int_0^{p} v\, dp$ where (**s**) is the displacement acted upon the force (**F**). Let us recall the relativistic equation of a linear momentum which is $\vec{p} = m\vec{v} = \frac{m_0 \vec{v}}{\sqrt{1-v^2/c^2}}$. When this formula is applied in the equation of the kinetic energy above , this gives:

$$KE = \frac{m_0\, c^2}{\sqrt{1-v^2/c^2}} - m_0 c^2 \approx \frac{1}{2}\, m_o v^2 \tag{1}$$

By defining the total energy (*E*) of the particle as the sum of the rest energy (E_0) and kinetic energy:

$$E = KE + E_{\circ} \tag{2}$$

And by combining (1) and (2), another equation is obtained which is $(KE + E_{\circ})^2 = E^2 = (pc)^2 + E_{\circ}^2$. Now, when considering a massless particle, which lacks a rest mass, and therefore rest energy, the previous equation will give $KE^2 = E^2 = (pc)^2$, and by taking the positive root of this equation, this gives:

$$KE_2 = E = pc \tag{3}$$

The kinetic energy which appears in this equation (3) is different from the kinetic energy in Eq(1) from two aspects:

(1)- The kinetic energy in Eq(3), is not a function in the particle's speed as does Eq(1), because the particle is massless, and considered to move with a constant speed (c). Therefore it cannot be defined as the work done by a specific force, in certain displacement just like the kinetic energy in equation (1).

(2)- The kinetic energy in Eq(3), represents the total energy of the particle, in comparison with the kinetic energy in (1) which represents only the additional part of energy which is acquired from motion(besides rest energy).

regarding these two differences the kinetic energy in Eq(3) it is not the same as that in Eq(1). Therefore, the simplest way to deal with the kinetic energy in Eq(3) is to consider it as another or second form (KE_2) of kinetic energy. Therefore, the total energy for "a free" massless particle (just like the EM quantum) is completely kinetic $KE_2 = pc$.

If we recall the second postulate of SAT, which states that, the kinetic energy(KE) and potential energy(PE) are the only forms of energy for ether's waves ($KE + PE$), a problem will emerge spontaneously. The potential represents the effect of the conservative forces which acting on the particle. Therefore, from this postulate when a particle is free (no action of any force), the kinetic energy will be the only form of energy. Initially, this makes a problem because many ether's waves are associated with quanta that have a detectable rest mass (like electron), and we know from the equation of energy-mass equivalence that this rest mass has an equivalent amount of rest energy. Apparently, this rest energy is neither kinetic energy nor potential energy, and still it contributes to the wave's energy($E = E_o + KE + PE$) , and from here comes the contradiction. Furthermore, even a massless particle (like photon) may not be completely massless; it may contain undetectable amount of rest mass(energy), which creates more contradiction with the second postulate of SAT.

To solve this problem, if we hold the second postulate of SAT as a valued principle, the rest energy (E_0) should be considered as a form of kinetic energy or simply a ***third*** form of kinetic energy (KE_3). Because at this situation, the total energy of any free particle will be completely kinetic ($E_0 + KE = KE_3 + KE$). The general notion or idea behind the kinetic energy is obtained from (1), which it represents an amount of energy that is acquired from motion. Therefore, redefining the rest energy (E_0) as a kinetic energy is done by defining it as a function in some kind of motion or speed (v_0):

$$E_0 \equiv KE_3$$

$$KE_3 = f(v_0)$$

where $E_0 = 0 \ when \ v_0 = 0$. Therefore the value of (E_0) will depend on (v_0). The main problem with this step is that the particle is at rest, which means that its speed and velocity equal zero, but this is not completely accurate, because the rest state by itself permits a particle to move in a specific type of motion. For the sake of demonstration, we can review the concept of this rest motion by taking three simple situations as an example. Initially, consider a classical particle that is located at the origin at the moment (t_1). At the moment (t_2) , the particle had moved to the right side, and its current position became ($\boldsymbol{A}$). Since the initial position of the particle was the origin, the magnitude of the displacement ($\Delta \boldsymbol{x}$) is equal to the current position of the particle. It is extremely important to note that every position that was located to the right side at the moment (t_1), had a value of ($\boldsymbol{x}$). But, at (t_2) the value has changed to $\vec{x} - \Delta \vec{x}$. Now, since $\Delta \boldsymbol{x}$ is equal to $\boldsymbol{A}$. By substitution, this simply gives $\vec{x} - \vec{A}$. **Figure (8).**

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 17 February 2021 doi:10.20944/preprints202102.0371.v1

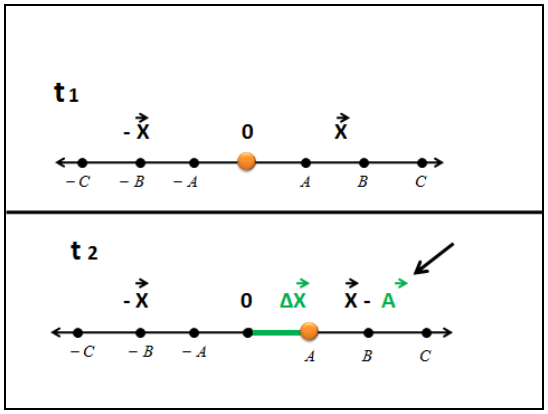

Figure 8. The particle is moving to the right ; $\vec{x}\ \ to\ \vec{x} - \ \vec{A}$

Our second situation is identical to the first, except that the particle has moved to the left side. We will see that every position that is located to the left side of the particle has changed from $-\boldsymbol{x}$ to $-\vec{x} - (-\ \vec{A})$. Where $-\boldsymbol{A}$ is the position of the particle at (t_2) **Figure 9**.

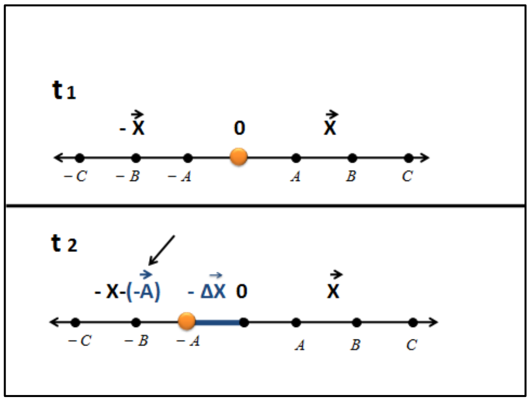

Figure 9. The particle is moving to the left ; $-\overrightarrow{x}\ to - \vec{x} - (-\ \vec{A})$.

Now, by look at our third situation in **Figure 10**. We should ask ourselves, where is the particle located at the moment (t_2) ?

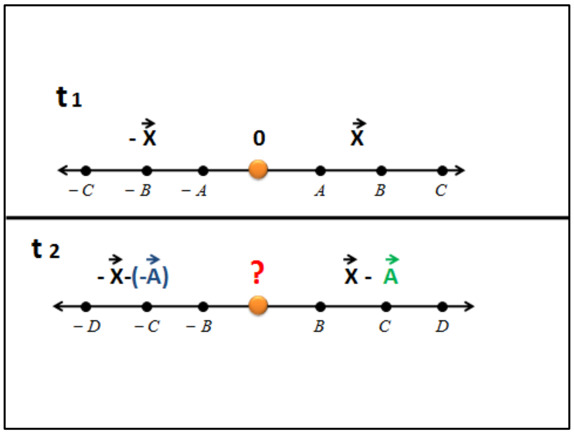

Figure 10. $\vec{x}$ *to* $\vec{x} - \vec{A}$ and $-\vec{x}$ *to* $-\vec{x} - (-\vec{A})$

By looking at the right side of the particle, we will see that the value of every position has changed to $\vec{x} - \vec{A}$, which indicates that the current position of the particle is **A**, since it is equal to the value of displacement. Also, by looking at the left side of the particle, we will say that the particle is located at − **A**, since the value of every position has been changed to $-\vec{x} - (-\vec{A})$. From here, we will have to conclude that at the moment (t_2), the particle is located at two positions, which are **A** , and − **A** , or by a simple mathematical expression $\vec{A} + (-\vec{A})$. This is equal to a single value; zero.

This means that the particle has not changed its position between (t_1) , and (t_2). If we divide our previous expression over the time interval between these two moments, we will get $\vec{v}_0 + (-\vec{v}_0)$. Where v_0 represents the rest speed of the particle. ***From here, we can say that the particle's velocity $\vec{v}$ is zero, but its rest velocity $\vec{v}_0$ is not zero***. The relation between the two velocities is simply given by $\vec{v} = \vec{v}_0 + (-\vec{v}_0) = 0$ We call it rest speed, because it describes the particle's motion while it is in rest, without changing its position. Or in other words, the particle is moving into two opposite spatial direction simultaneously. The value of this rest speed v_0 determines how the values of the surrounding positions around the particle change with time, and these changes have the same magnitude, but with opposite direction **Figure 10.**

3- Defining Gravity as a Consequence of the Rest Motion:

The previous description of the rest motion is just a primitive or initial description; therefore it is not applicable in nature by its current form. To get an accurate description of the rest motion, let us consider a body with relatively huge mass(M) , this body will be chosen to be:

(1)- Static, so that the body will has only one type of motion, which is the rest motion, and any other type of motion is neglected.

(2)- Spherically symmetric with radius (r_0), so that the value of the rest motion (**v_0**+ (-**v_0**)), will be the same, regardless of the spatial direction which is chosen (x, y, z).

We recall the following equation from the previous section:

$$E_0 \equiv KE_3$$

$$KE_3 = f(v_0)$$

Since $E_o = Mc^2$, and c^2 is a constant value, then we can obtain the following equation:

$$M = f(v_0) \tag{4}$$

Now, let us look at the following hypothetical physical equation between two variables (A, J) :

$$A = \frac{J\,P}{Y}$$

The relation between the variables will be the same in this equation whether you consider that (A) is function in (J), or (J) is function in (A), since the dimensional analysis will be the same in both cases. But it will only change the definition of the function. By getting back to our problem, a similar step will be taken in order to simplify the calculations by assuming that $v_0 = f(M)$ instead of the previous equation $M = f(v_o)$.

The effects of the rest motion will be considered outside the body only for the sake of simplification. Now, let us take the following example **Figure 11**. In this example, we have two observers with two clocks. The first is located at the surface of this body, therefore, it is affected by its rest motion. The second observer (clock) ***should not*** be affected by the rest motion of this body. But initially, we lack the complete description for the physical properties for this rest motion. Therefore, we do not know where to locate this observer (clock) in order to be not affected by the rest motion of this body. But apparently, it should not be located at the surface, beside the first observer (clock), because it will be affected by its rest motion. For this reason, its exact position is considered to be unknown. The symbol (r) stands for the radial distance, which is the distance from the center of the body **Figure 11.**

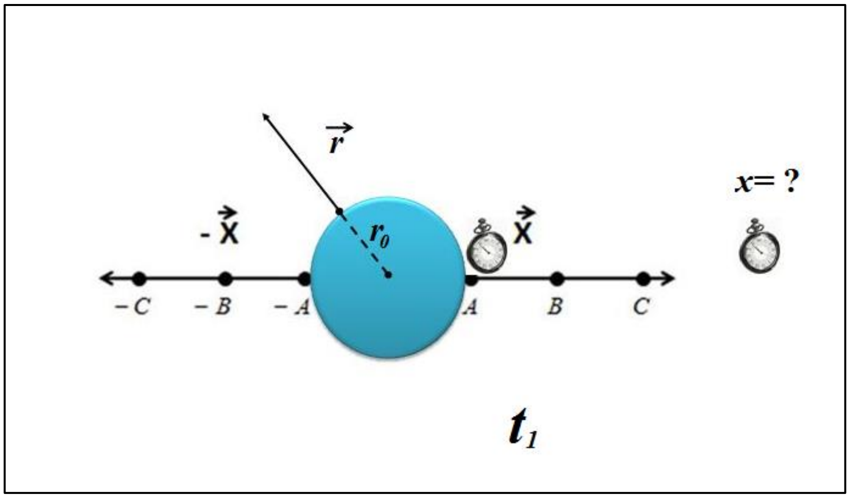

Figure 11. *A spherical body, with two observers (clocks) at* (t_1)

By applying the same concept of rest motion that we have introduced in the previous section; At the moment (t_1) the first observer (clock) in position (**A**) in (**x**) axis **Figure 11** . But at the moment (t_2), due to the effect of rest motion, the position of the first observer (clock) is changed to (**B**) **Figure 12.**

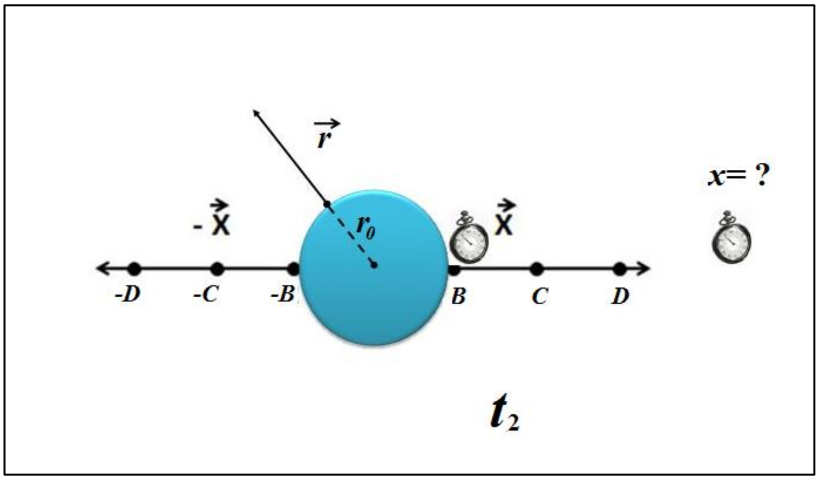

Figure 12. *At the moment (t_2), the position of the first observer(clock) is changed.*

Since the position of the first observer (clock) has changed between the two moments (t_2-t_1). This means that the first observer (clock) is moving, with a speed ***equals to the body's rest speed, and it is a constant value***. As we have discussed in the introduction, the first postulate of SAT implies a constant speed of light propagation with constant motion between observers. This in turn implies a distortion in spacetime measurements between them. Therefore, this clock (observer) should give a ***dilated*** measurement for time with respect to the second clock (observer), since it is moving. Also, length should be contracted along the direction of (***x***), which is the same direction of the radial vector (**r**), due to the same movement. From here, we can see that the measurements of space (length), and time are ***curved or distorted*** between the position of the first observer (clock) to the unknown position of the second observer(clock) (unaffected by rest motion).

The value of rest motion remains fixed with time, since it $v_0 = f(M)$, and $(Mc^2 = E_0)$ is a conserved quantity. Therefore, we can use the relativist equations for time dilatation and length contraction, between the two observers:

$$\Delta t = \frac{\Delta t'}{\sqrt{1 - v_0^2/c^2}} \tag{5}$$

$$dr = dr'\sqrt{1 - v_0^2/c^2} \tag{6}$$

but from another perspective, the position of the first observer(clock) ***did not change between the two moments (t_2-t_1) with respect to the radial coordinates*** (**r**). The radial coordinate of the first clock (observer) is fixed with time. **Figure 11** and **Figure 12**. From here, we can conclude this; the effect of the rest motion is simply interpreted as a ***curvature of time and spatial*** measurements along the radial coordinate (**r**), and the value of this curvature increases with the value of rest motion.

From Eq (4), when the magnitude of the rest speed equals zero($v_0 = 0$), the mass and the rest energy of the body should also be zero($E_0 = M = 0$) . This situation is physically identical to the following; Consider an observer located in a free space-time, with no any detectable mass surrounding him($E_0 = M = 0$). In this situation the value of the rest speed that affects this observer is zero($v_0 = 0$) due to absence of any mass(rest energy) surrounding him. But this does not really mean that the mass (M) does not exist; it may exist, but it is distributed over infinite volume in space. Therefore, the content of mass in a given spatial volume equals zero, since it distributed over an infinite

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 17 February 2021 doi:10.20944/preprints202102.0371.v1

spatial volume **Figure 13**. Mathematically, the distribution of mass in space can be expressed by (D_M) , which represents the mass density $(mass/spatial\ volume)$.

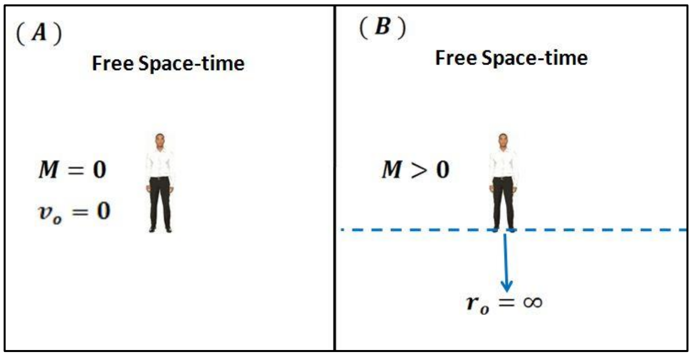

Figure 13. The two situations in (A) and (B) are physically identical. (A) the absence of a detectable mass in a free spacetime $(M = 0)$ means no value of rest motion that can affects the observer$(v_0 = 0)$. But this does not really mean that the mass does not exist ($M > 0$) as you can see in (B). It may exist, but it is distributed over infinite spatial volume; the dashed line refers to the imaginary surface of the spherical mass, and the arrow below the observer points to the mass's center, and as demonstrated its distance is infinite$(r_0 = \infty)$. Therefore, the value of mass in any limited volume around the observer is zero, which is identical to (A). Therefore, if the rest motion which affects the observer (v_0) equals zero in (A). Then, it should also be zero in (B) , since (A) and (B) are physically identical.

From here, the previous equation $v_0 = f(M)$ should be modified to the following:

$$v_0 = f(D_M)$$

where v_0=0, when D_M = 0.For a spherical body, the mass density $D_M = M/\frac{4}{3}\pi r^3$ depends on two variables, which are the amount of rest mass (M), and the radius (r). Hence, the previous equation $v_0 = f(D_M)$ could be written as $v_0 = f(M, r)$.

Now, by getting back to figure (6), regarding the second observer which is not affected by the rest motion of the mass (M). His distance from the mass is assumed to be unknown. But now, we can simply calculate this distance by using the previous equation. For him, in order to be not affected by the rest motion $(v_0 = 0)$ which implies that $(D_M = 0)$; from the formula of mass density $D_M = M/\frac{4}{3}\pi r^3 = 0$, yields $r = \infty$. Therefore, this observer should be separated by infinite distance from the center of mass (M). This represents an imaginary location, since (∞) is undefined mathematical quantity.

The final step is to calculate the value of (v_0); assume that observer (2) in **Figure 11** has a test particle with a rest mass (m_0) which is negligible compared with (M) in order to ignore its effects of rest motion. The test particle's energy at observer's (2) is m_0c^2. But when this test particle is moved to observer (1) on the surface of (M), it will has an additional kinetic energy, because it will be moving with the observer (1) with the same rest speed(v_0). By using the relativistic kinetic energy formula:

$$KE_1 = \frac{m_0c^2}{\sqrt{1 - v_0^2/c^2}} - m_0c^2 \quad (7)$$

We recall that $v_0 = f(M, r)$, but with a specific body (M), the value (v_0) will be only a function in (r). This also means that the kinetic energy for this test particle in (7) will change with (r) as $KE_1 = f(r)$. As we know, the kinetic energy represents the work (W) done by a force (**F**) for a specific displacement value as $dKE = d\,W = \vec{F}.d\vec{r} = F\,dr$ where (r) is the magnitude of the radial position vector (**r**) from the center of the body. Therefore, if this test particle is shifted from (∞) to (r_o) , then the kinetic energy of this test particle will be equivalent to Eq (7) as $KE_1 = \int_{\infty}^{r_0} F\,dr$, which yeilds:

$$KE_1 = \frac{m_0c^2}{\sqrt{1-v_r^2/c^2}} - m_0c^2 \tag{8}$$

where (v_r) is speed of the test particle along (**r**) detected by observer (1) when the test particle reaches the body surface. Now, the kinetic energy in (8) represents the same kinetic energy in (7), therefore, by comparing them, this gives:

$$v_r = v_0 \tag{9}$$

if the test particle loses its kinetic energy in (8), when it reaches the surface of the body (M).Then, it will be restricted on the body surface by a potential energy (*PE)* of the same magnitude of its previous kinetic energy:

$$PE = -\left(\frac{m_0c^2}{\sqrt{1-v_r^2/c^2}} - m_0c^2\right) \tag{10}$$

Therefore, from the previous equation (10), the value of (v_r) will be the same speed needed for the test particle to escape from the body surface along the direction of (**r**). Now, if all the previous physical effects of the rest motion of the body (M) is considered to be ***equivalent to the gravitational effects around it***. This means that ($\mathbf{v}_r$) will represent the gravitational escape velocity, which its magnitude can be simply obtained from Newton's law of gravitation as $v_r^2 = 2GM/r_0$ .From Eq (9), the value of (v_0) is the same as the previous equation:

$$v_r = v_0 \qquad\qquad v_0^2 = 2GM/r_0.$$

By applying the value of (v_0) in Eq (5), and Eq(6):

$$\Delta t = \frac{\Delta t\prime}{\sqrt{1-\frac{2GM}{r_0c^2}}} \tag{11}$$

$$dr = dr'\sqrt{1-\frac{2GM}{r_0c^2}} \tag{12}$$

also by substituting the value of (v_r) in (10), the magnitude of the force which affects the test particle is easily calculated $F = -\frac{dPE}{dr}$ as :

$$F = G\frac{Mm_0}{{r_0}^2}\left(1-\frac{2GM}{r_0c^2}\right)^{-\frac{3}{2}} \approx G\frac{Mm_0}{{r_0}^2} \tag{13}$$

The third form of kinetic energy (KE_3) for the body (M) with a specific radius (r_0) is simply calculated from $v_0^2 = \frac{2GM}{r_0}$ Since the rest energy of the same body is $KE_3 = E_0 = Mc^2$. By combining these two equations, this gives:

$$KE_3(v_0) = \frac{r_0 c^2 v_0^2}{2G} \tag{14}$$

this represents the third form of kinetic energy for a symmetrically spherical, static body, with a specific radius (r_0) which satisfies $E_0 \equiv KE_3 = f(v_0)$.

It is important to note that acceleration which appears in Eq (13) breaks the symmetry of the relative motion of (v_0) between observers (1) and (2) in **Figure 11** and **Figure 12**. Because the situation is similar to the famous *twins paradox* in Special Theory of Relativity. Therefore, the space-time distortion which is demonstrated by Eq (11), and Eq (12) will not be a reciprocal effect between the two observers. Another point is that these two equations are mathematically identical to the Schwarzschild solution, which represents one of the simplest solutions to Einstein's field equations of general relativity. This solution can be applied to the orbiting Planets in our Solar system as sort of approximation. A last point to clarify is that the gravitational time dilatation formula in Eq (11) and the gravitational force in Eq (13) stand for the same physical effect. To explain this, take a beam of monochromatic EM waves passing along the vector (**r)** toward the previous body (M). The quantum of this radiation will carry a linear momentum of magnitude $p = h\nu/c$, where *h:* Planck's constant, *ν:* wave's frequency. Now, if there is a force affecting this quantum along it its path in (**r**), it means that the momentum will change with time as long as the quantum passing through (**r**), or $F = dp/dt > 0$ which represents the physical effect of the force. Therefore, there will be a shift in the frequency associated with this shift of the momentum as $\Delta p = h\Delta\nu/c$. This shift in the frequency can be interpreted as a physical effect for the gravitational time dilatation.

A major challenge which remains unsolved is to draw a picture for gravity at the quantum level; Quantum Gravity. In my opinion, and for two reasons, I think that Loop Quantum Gravity (LQG) is the most promising candidate to solve this problem [7][8]. The first reason is that (LQG) preserves the general notion of gravity as described by the General Theory of Relativity; background- independent interaction. Because the existence of this picture of gravity (spacetime curvature) can be easily justified as I have just introduced in this paper. The second reason is that I have recently introduced an evidence which the support the main prediction of LQG which is the existence of spatial granules; elementary indivisible spatial components [9].

Conclusion:

The curvature of spacetime around a static, spherically symmetric mass results from its rest motion. This rest motion occurs because the amount of energy in this mass is not a rest energy. But instead it is a form of kinetic energy, and for a mass with a specific radius(r_o), I have found that this kinetic energy is directly proportional to square value of its rest motion as $KE_3 = \frac{v_0^2}{2}\left(\frac{r_o c^2}{G}\right)$, which astonishingly resembles the classical formula of kinetic energy as $KE_1 = \frac{v^2}{2}(m)$.

References:

[1] Einstein, Albert ***(1961****), Relativity: The Special and the General Theory, New York: Three Rivers Press (published 1995).*

[2] Carroll,S,**(2004)** Spacetime and Geometry: An Introduction to General Relativity, Addison-Wesley.

[3] Isam, A **(2015).** A New Medium for Matter and Light Waves, American Research journal of Physics, Vol.1,No.1, pp. 36-55.

[4] *Isam, A(**2016)** The Perfect Universe: A new perspective for light, matter, and gravity, Noor Publishing.*

[5] Michelson, A. A. & Morley, E. W. (1887), On the Relative Motion of the Earth and the Luminiferous Ether, American Journal of Science **34**(203): 333–345.

[6] Davies, P.C.W. and Brown, J., Eds. **(1988)** Superstrings: A Theory of Everything? Cambridge University Press, Cambridge.

[7] *Rovelli, C,**(2004)** Quantum Gravity, Cambridge University Press.*

[8] *Smolin ,L **(2004)** " Atoms of space and time" Scientific American,***290(1):**66-75.

[9] *Isam, A. (2018) Spacetime Discreteness: Shedding Light on Two of the Simplest Observations in Physics. Journal of Modern Physics, 9, 1415-1431.*

.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 17 February 2021 doi:10.20944/preprints202102.0371.v1