Journal of Modern Physics, 2021, 12, 1281-1294
https://www.scirp.org/journal/jmp
ISSN Online: 2153-120X
ISSN Print: 2153-1196

Gravitational Energy Levels: Part Two

Edward Tannous

Independent Researcher, Jaffa, Israel
Email: Etannouss@gmail.com

How to cite this paper: Tannous, E. (2021) Gravitational Energy Levels: Part Two. *Journal of Modern Physics*, **12**, 1281-1294.
https://doi.org/10.4236/jmp.2021.129079

Received: May 15, 2021
Accepted: July 17, 2021
Published: July 20, 2021

Abstract

We present here a model that explains in a simple, easy and summarized manner, the values, meaning and reasons for the force of gravity, using simple physical tools. According to this model, a gravitational field actually creates different energy levels, similar to the atom, around the center of mass of the gravitational source, and a transition between the energy levels results in the creation of the force of weight acting on each small body which is in the gravitational field. As the body approaches a gravitational field, its energy value decreases to a value of $m_0 u_{(R)}^2$, proportional to the distance R between the centers of the masses, when $u_{(R)}$ is the magnitude of the self-speed of light vector (the progression in the time axis) of the small body, and its value decreases as it approaches the center of the origin of the field. This change in the energy levels is the cause of the force of gravity. A formula is obtained for the concept of potential gravitational energy and the variables on which it depends, and for the time differences between two frames that are in the gravitational field, taking into account the motion and location of each frame. It is obtained from this model that the speed of light is also a variable value as a result of the effect of the gravitational field.

Keywords

Force of Gravity, Potential Energy, Kinetic Energy, Time Differences between Frames, Gravitational Curvature of Light Beams

1. Introduction

This article is a continuation of previous articles called "Negative Mass" ref. [1] and "Energetic Angle" ref. [2], which present a model of a body, in accordance with the theory of special relativity, which is in constant motion in space (at high velocities close to the speed of light), so that the body has a velocity equal to the speed of light in the space-time, has an energetic angle and a negative mass. This model shows that each body moves at the speed of light in the space-time, and in a different direction, which is called the "self-speed of light vector", depending on the velocity of each body relative to another body.

The present research paper also refers to Einstein's general theory of relativity ref. [3] and gives diverse answers using the basic laws of physics, which are the cornerstones of this science, especially the Energy Conservation Law ref. [4] and Newton's Laws ref. [5], to various issues in physics, such as black hole ref. [6].

Albert Einstein's formula describing the rest energy of a body with mass (m) is given by the formula $E = mc^2$ ref. [7]. As mentioned in the previous articles ref. [1] [2], the energy is divided into two parts:

A. Self-time energy E_{st}, which determines the amount of energy left in the mass as a result of the velocity.

B. State kinetic energy E_α, which is the energy that the body carries within it in the reference frame, as a result of the velocity.

State kinetic energy also includes other forms of energy and not just kinetic energy, such as potential energy.

Therefore, the total energy of the body is: $E = E_{st} + E_\alpha$. In case the body is free, *i.e.* outside the gravitational field: $E = E_0 = E_{st} + E_\alpha = m_0 c^2$. In this article, we show the total energy of the body in a gravitational field.

2. A Body in a Gravitational Field

Initially, we refer to a small body which approaches a large body under the influence of a gravitational field. The body loses some of its self-time energy E_{st}, because it is exerted by a gravitational force $F_{(R)}$, which is a conservation force. The magnitude of the energy it loses is equal to the amount of work invested: $\int_R^\infty F(R)\,\mathrm{d}R$, where R is the distance between the center of the small body m and the center of the large body M, as shown in **Figure 1(a)**.

Therefore, the self-time energy (mass energy) E_{st} of the small body will decrease as it gets closer to the large body. This decrease in the value of the energy is not at the expense of the magnitude of the mass (which, naturally, does not change), but at the expense of the self-speed of light vector which we marked in

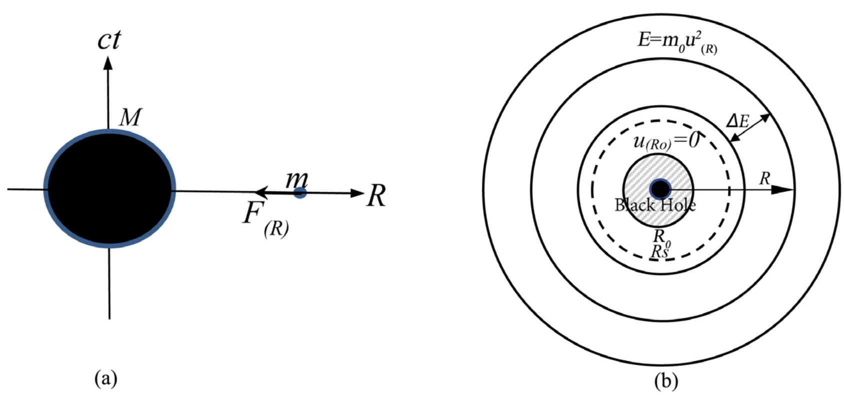

Figure 1. (a): Small body m under the influence of a gravitational field of a large body M; (b): Description of the energy levels of a black hole, while indicating the zero horizon R_0, and the event horizon R_s.

the previous article in $\boldsymbol{C}$ ref. [1]. Because of the effect of the gravitational field, we mark the self-speed of light vector by $\boldsymbol{U}_{(R)}$, since its magnitude is not equal to the speed of light, but is smaller as it gets closer to the center of mass of the gravitational field source, therefore it depends on the distance R, *i.e.*, $\left|\boldsymbol{U}_{(R)}\right| = u_{(R)} < c$.

We calculate the energies of the body under the influence of a gravitational field at a distance R, where the body m_0 is at rest relative to M, *i.e.*, $\alpha = 0$ as shown in **Figure 2(a)**.

Self-time energy (mass energy):

$$E_{st} = m_0 \boldsymbol{C} \boldsymbol{U}_{(R)} = m_0 c u_{(R)} \tag{1}$$

wherein:

$\boldsymbol{C}$—The self-speed of light vector of the large body.

$u_{(R)}$—The absolute value of the self-speed of light vector of the small body $\boldsymbol{U}_{(R)}$, *i.e.* $u_{(R)} = \left|\boldsymbol{U}_{(R)}\right|$.

The state kinetic energy, which is the potential energy only in this case, since there is no motion in the R direction:

$$E_\alpha = m_0 \boldsymbol{U}_{(R)} \underbrace{\left(\boldsymbol{U}_{(R)} - \boldsymbol{C}\right)}_{V_{ax}} = m_0 u_{(R)}^2 - m_0 c u_{(R)} \tag{2}$$

Therefore, the total energy of the small body under the influence of a gravitational field is:

$$E = E_{st} + E_\alpha = m_0 u_{(R)}^2 \tag{3}$$

Initially, if a small body m_0 is at rest at a distance of R from a large body M, the amount of work required, by a conservation and variable force accordingly, to move the body to a completely free state, *i.e.* out of gravitational influence, is calculated using Newton's law:

$$W_{(R\to\infty)} = \int_R^\infty F_{(R)} \mathrm{d}R = \int_R^\infty m_0 \frac{GM}{R^2} \mathrm{d}R = m_0 \frac{GM}{R} \tag{4}$$

wherein G is Newton's gravitational constant.

According to the law of conservation of energy, the amount of work we calculated in Formula (4) is the same amount of energy that the body loses,

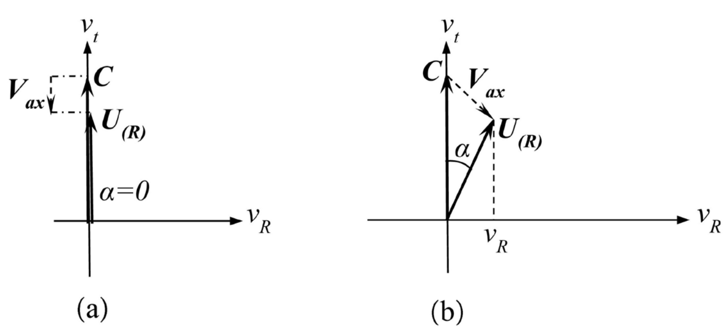

Figure 2. (a) An array of self-speed of light vector of the large body C and the small body $U_{(R)}$, at rest. (b) An array of self-speed of light vector of the large body C and the small body $U_{(R)}$, moving at velocity v_R.

approaching a gravitational field to a distance of R, *i.e.*, $W_{(R\to\infty)} = W_{(\infty\to R)}$. This amount of energy is the amount that the body loses from the self-time energy (mass energy) E_{st}.

Using Formula (1), we obtain that the difference between the self-time energy (mass energy) E_{st} in a completely free state (outside the gravitational field) $E_{st} = m_0c^2$ and the energy under gravitational influence $E_{st} = m_0cu_{(R)}$ is the amount of work we calculated in Formula (4):

$$\Delta E_{st} = m_0c^2 - m_0cu_{(R)} = W_{(R\to\infty)} = m_0\frac{GM}{R} \tag{5}$$

Thus we obtain the size of the self-speed of light vector of each small body, which is at a distance of R from a large body (star) with a gravitational field:

$$u_{(R)} = c - \frac{GM}{cR} \tag{6}$$

$u_{(R)}$ is the magnitude of the self-speed of light vector of the small body in space-time under the influence of a gravitational field, and is always smaller than the speed of light c in its absolute value. Therefore, and from Formula (6), a number of conclusions can be drawn:

1) **Energy**: The self-speed of light vector of each body at a distance R will be $\boldsymbol{U}_{(R)}$, therefore in any energetic state it will have total energy $E = m_0u_{(R)}^2$. That is, the sum of the self-time energy (mass energy) E_{st} and the state kinetic energy E_α will always be $E = E_{st} + E_\alpha = m_0u_{(R)}^2$. As the body gets closer to the large body, its energy will decrease accordingly.

2) **Horizon Zero** is the state where:

$$R_0 = \frac{GM}{c^2} \tag{7}$$

According to Formula (6), it seems that the self-speed of light vector of the body in this state will be equal to zero, *i.e.*, it cannot move in any direction at any energetic angle. Furthermore, its energies become zero $E = E_{st} = E_\alpha = 0$, on this horizon it will be in a state of freezing in time, *i.e.*, its time is not advancing.

If a zero horizon Ro exists outside the mass of the large body (the star), it is a black hole. This can be seen in **Figure 1(b)**.

3) **Time**: Each body at rest, at a distance R, will have a slower time than a free body at a difference of $\Delta T = \frac{cT - u_{(R)}T}{c} = \frac{GM}{c^2R}T = \frac{R_0}{R}T$

4) **Mass**: Although the mass m_o does not change in shape and composition, its measured value m (effective mass) is small under the influence of the gravitational field. Since the self-time energy (mass energy) is smaller $E_{st} = m_0\boldsymbol{CU}(R) = m_0cu_{(R)}\cos\alpha = mc^2$ (α is the energetic angle, assuming that the body moves in some direction in the Euclidean space (x,y,z), so that its velocity is $v = u_{(R)}\sin\alpha$ ref. [1] [2]), we obtain an effective mass in this case:

$$m = m_0\frac{u_{(R)}}{c}\cos\alpha = m_0\left(1 - \frac{GM}{c^2R}\right)\cos\alpha = m_0\left(1 - \frac{R_0}{R}\right)\cos\alpha \tag{8}$$

5) **Gravitational force**: The gravitational force [8], in fact, is created as a result of a transition between the different energy levels, see **Figure 1(b)**.

6) **Speed of light:** Below it appears that the speed of light under the influence of a gravitational field is equal to $u_{(R)}$.

3. Potential Energy

Many physicists have failed to explain the fact that potential energy $E_p = mg\Delta R$ depends proportionally on the magnitude R. That is, the farther away from the star, the greater the potential energy, but if we set the value of $g = \frac{GM}{R^2}$, we obtain that $E_p = m\frac{GM}{R^2}\Delta R$, where the potential energy is inversely proportional to R. In addition, another question is if the potential energy is positive or negative. Here we give an exact expression of the potential gravitational energy.

The state kinetic energy is an energy that contains within it the two energies, both the kinetic and the potential. If we take a body at rest at a distance R as shown in **Figure 2(a)**, in this case all the state kinetic energy is a potential energy, because the body is at rest, as we obtained in Formula (2). If we set the value of $u_{(R)}$ from Formula (6), we obtain the expression of the potential energy:

$$E_p = E_{\alpha=0} = m_0\left(\frac{G^2M^2}{c^2R^2} - \frac{GM}{R}\right) \tag{9}$$

The potential energy can also be written, using Formula (7), as follows:

$$E_p = m_0\frac{GM}{R}\left(\frac{R_0}{R} - 1\right) \tag{10}$$

If we analyze the function of the potential energy E_p, it seems that it always has a negative value (assuming that $R \geq R_0$). The potential energy is equal to zero in two places, $E_p = 0$, when $\begin{cases} R = R_0 \\ R = \infty \end{cases}$. The minimum value is obtained when R is equal to:

$$R_s = 2\frac{GM}{c^2} = 2R_0 \tag{11}$$

This is the Schwarzschild radius that represents the Event horizon ref. [9] [10].

It is easy to show that if we calculate the difference in the potential energy between two radii close to each other R_1 and R_2 (when $R_2 > R_1$), under the influence of a weak gravitational field (such as Earth), we obtain:

$$\Delta E_p \approx m_0\underbrace{\frac{GM}{R^2}}_{g}\underbrace{(R_2 - R_1)}_{h} = m_0gh$$

4. Kinetic Energy

As mentioned earlier, state kinetic energy E_α contains within it two types of energy, kinetic energy and potential energy, *i.e.*:

$$E_\alpha = E_p + E_k \tag{12}$$

Figure 2(b) shows a body at a distance R moving with the velocity $v = u_{(R)} \sin\alpha$, having a self-speed of light vector $\boldsymbol{U}_{(R)}$. The state kinetic energy will be:

$$E_\alpha = m_0 \boldsymbol{U}_{(R)} \left(\boldsymbol{U}_{(R)} - \boldsymbol{C} \right) = m_0 u_{(R)}^2 - m_0 c u_{(R)} \cos\alpha$$

When we subtract from the state kinetic energy the value of the potential energy (Formula (2)), we obtain the exact value of the kinetic energy:

$$E_k = m_0 c u_{(R)} \left(1 - \cos\alpha\right) = 2 m_0 c u_{(R)} \sin^2\left(\frac{\alpha}{2}\right) \tag{13}$$

In a weak field and at low velocities, using approximations that $\sin^2\left(\frac{\alpha}{2}\right) \approx \left(\frac{\alpha}{2}\right)^2 \approx \frac{\sin^2\alpha}{4}$, $u_{(R)} = c$ and the formula $v = u_{(R)} \sin\alpha$, we obtain the known formula for kinetic energy: $E_k = \frac{m_0 v^2}{2}$.

5. Escape Energy and Escape Velocity

In order to be free from the effect of the gravitational field, we must give the small body an escape energy, which is a kinetic energy equal in its absolute value to the potential energy that we calculated earlier, but with the opposite sign, so that their sum (state kinetic energy) is equal to zero $E_\alpha = E_p + E_k = 0$, *i.e.*:

$$E_{k(\text{Escape})} = -E_p = m_0 \left(\frac{GM}{R} - \frac{G^2 M^2}{c^2 R^2} \right) = m_0 \frac{GM}{R} \left(1 - \frac{R_0}{R} \right) \tag{14}$$

R_0 is a zero horizon, and has a relatively small value existing outside the mass, in cases of black holes only. Therefore when R is much larger than R_0, it can be written approximately:

$$E_{k(\text{Escape})} = m_0 \frac{GM}{R} \tag{15}$$

If $E_{k(\text{Escape})}$ is equal to E_p, then we obtain that the state kinetic energy E_α, which is actually their sum, will be equal to zero, according to Formula (12). According to Formula (2), we see that the state kinetic energy is a Dot product of two vectors: $E_\alpha = m_0 \boldsymbol{U}_{(R)} \boldsymbol{V}_{ax} = m_0 u_{(R)} v_{ax} \cos\beta$, when $\boldsymbol{V}_{ax}$ is the separation velocity in space-time of two bodies ref. [1] [2]. The value of the state kinetic energy becomes zero when the angle between the two vectors $\boldsymbol{U}_{(R)}$ and $\boldsymbol{V}_{ax}$ is 90˚, as shown in Figure 3.

From the two formulas:

$$\cos\alpha = \frac{u_{(R)}}{c} = 1 - \frac{GM}{c^2 R}$$

$$v_{(R)(\text{Escape})} = u_{(R)} \sin\alpha$$

The escape velocity is obtained:

$$v_{(R)(\text{Escape})} \geq \left(1 - \frac{GM}{c^2 R} \right) \sqrt{2 \frac{GM}{R} - \frac{G^2 M^2}{c^2 R^2}} \tag{16}$$

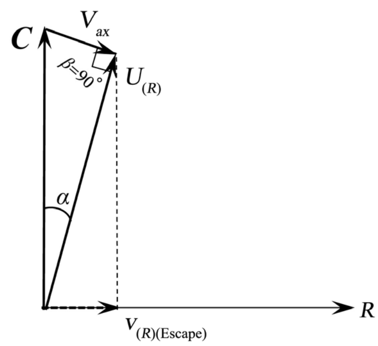

Figure 3. A description of the escape velocity in space-time, when the state kinetic energy is equal to zero.

It is clear that under the influence of a weak gravitational field, *i.e.*, far from zero horizon, we obtain that the escape velocity is $v_{(R)(\text{Escape})} \geq \sqrt{2\frac{GM}{R}}$.

As mentioned earlier, a body with an escape velocity causes the state kinetic energy to become zero, to any value of R. That is, on the way to the escape, the angle between $\boldsymbol{U}_{(R)}$ and $\boldsymbol{V}_{ax}$ in space-time will always be 90˚, until it reaches a distance large enough to detach from gravity, as shown in **Figure 4**. The separation velocity between the two bodies, the large body and the small body $\boldsymbol{V}_{ax}$ in the space-time, will decrease to a value of zero in the infinity, so the value of vector $\boldsymbol{U}_{(R)}$ will be equal to the speed of light $\boldsymbol{C}$ in an absolute manner. Another thing that is obtained from the fact that the state kinetic energy becoming zero is that the total energy E of the small body is equal to the energy of the self-time E_{st}, that is $E = E_{st}$, because $E_{\alpha} = 0$.

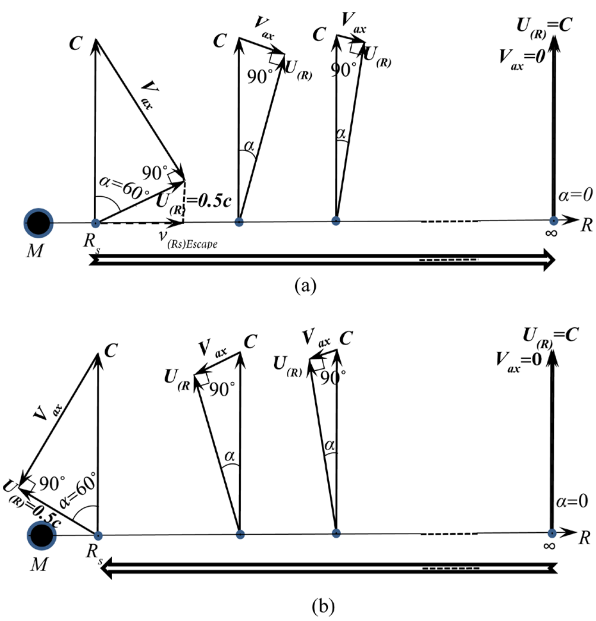

Figure 4. (a) A body with escape velocity maintains the state kinetic energy as zero along the way until it detaches from the gravitational field effect. (b) The process is reversible, *i.e.*, a body approaching a gravitational field receives the same values of energies.

In the inverted state, *i.e.*, when a small body is attracted to a large body from a great distance from a rest state, it undergoes the same process with the same parameters and magnitudes of the energies, in the opposite direction, as shown in **Figure 4**. When it reaches the event horizon R_s, its self-speed of light vector obtains a value of $u_{(R)} = 0.5c$, according to Formula (6), therefore the energetic angle will be $\alpha = 60^\circ$, and its velocity on the R axis will be at its maximum value, equal to: $v_{(Rs)\text{Escape}} = u_{(Rs)} \sin\alpha = 0.433c$. This is the escape velocity from the event horizon, as shown in **Figure 4(a)**. In other words, the total energy and self-time energy of the small body on the event horizon is $E = E_{st} = 0.25 m_0 c^2$. The state kinetic energy is equal to zero $E_\alpha = E_k + E_p = 0$, but its components are of value $E_k = E_p = 0.25 m_0 c^2$. Therefore, in order to free the small body from the event horizon, we must invest in it kinetic energy equal to $E_k = 0.25 m_0 c^2$.

6. Satellite Time

As is well known, GPS satellites must be synchronized in time on Earth in order to get maximum accuracy. Furthermore, NASA's International Space Station (ISS) also needs to be synchronized to a clock on Earth in order to perform certain experiments. Therefore, we take these two examples as an example of our model test ref. [11].

Looking at the Earth, which is a relatively small planet, we try to test Formula (6). We obtain that the difference between the self-speed of light vector $\boldsymbol{C}$ of a free body (outside a gravitational field), which has an absolute value of the speed of light $|\boldsymbol{C}| = c$ and a body under the influence of the gravitational field of earth is so small, that it can reach a maximum value, on the surface of the earth, at a rate of $\Delta u = c - u_{(R)} = \dfrac{GM}{cR} \approx 0.21[\text{m/sec}]$. This is a velocity that seems negligible in relation to the speed of light, but this velocity creates a difference of $\Delta T = \Delta u T / c = 60$ μsec in one day, *i.e.* during a day of $T = 86{,}400$ sec, our time on Earth is slower by 60 μsec per day, relative to the free body, as shown in **Figure 5**.

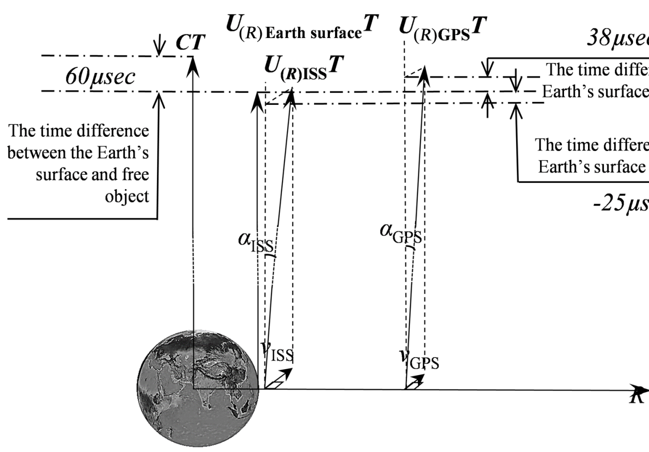

Figure 5. Description of time differences in a day, between ISS and GPS satellites and the time on Earth.

The time difference between a free body (in this case we take the Earth's core as reference, as a point mass in space) and a body under the influence of a gravitational field (satellite), moving at v in space x, y, z when the energetic angle α is obtained from the expression $v = u_{(R)} \sin\alpha$, we calculate the projection of the timeline, as shown in Figure 5: $c\Delta T = cT - u_{(R)} T \cos\alpha$

We insert Formula (6) and we obtain:

$$\Delta T = T\left(1 - \cos\alpha + \underbrace{\frac{GM}{c^2 R}}_{\frac{R_0}{R}} \cos\alpha\right) \tag{17}$$

Formula (17) expresses the time differences between two reference frames of two bodies, one is a free stationary body (without gravitational effect), and the other is a mobile body under gravitational field influence. Therefore, it can be seen that this formula contains within it the two theories of private and general relativity together.

A table was constructed to calculate the time differences in a day, according to Formula (17) and the above data.

The results of Table 1 can be seen schematically in Figure 5, which depicts the self-speed of light vectors of each one of the frames, and its projection on the frame axis.

Table 1. The time differences of the ISS and GPS satellites in a day, taking into account the gravitational field and satellite motion.

	Distance R (m)	Velocity V (m/sec)	The energetic angle α (rad)	Time difference in a day ΔT (sec)	Time difference in a day relative to the surface of the earth
Free body (Earth Core)	0	0	0	0	+60 µsec
The surface area of the Earth	6,357,000	0	0	60 µsec	0
Satellite ISS	6,767,000	7700	2.56838×10^{-5}	85 µsec	−25 µsec
Satellite GPS	26,541,000	3874	1.29219×10^{-5}	22 µsec	+38 µsec

7. The Speed of Light under the Influence of a Gravitational Field

Figure 6(a) depicts a self-speed of light vector of a small body moving to the center of the large body (star), at point B, at a velocity $v_{(R)}$ with an energetic angle α such that $v = u_{(R)} \sin\alpha$ Figure 6(b) depicts an ICF (Integral Couple Frame) ref. [1]. Figure 6(c) depicts the line of light from point B to point A. In space-time, two very close points are chosen, as is well known $\beta = (\pi/2 - \alpha)/2$ ref. [1]. Therefore, the speed of light in this small interval is:

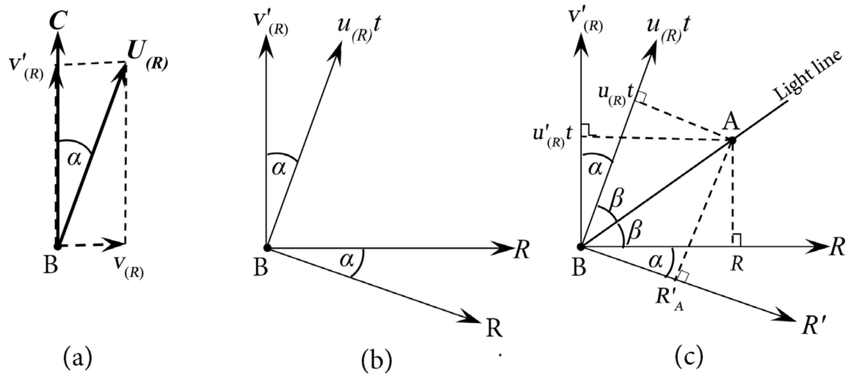

Figure 6. (a) Description of the self-speed of light vectors of the small body $U_{(R)}$ moving at a velocity $v_{(R)}$, and of the large body C; (b) ICF (Integral Couple Frame); (c) Description of the light path in the ICF frame.

$$\begin{aligned}\text{Gravitational light speed} &= \frac{R_A}{t_A} = \frac{u_{(R)}t_A}{t_A} \\ &= u_{(R)} = c - \frac{GM}{cR}\end{aligned} \tag{18}$$

Therefore, the speed of light, under the influence of a gravitational field, at a distance R, is equal to $u_{(R)}$.

As another example, two spaced apart points A, B are chosen. A beam of light traveling from point A to point B passes through a gravitational field, as shown in Figure 7. The trajectory that the beam will travel will be the shortest optical path length, according to Fermat's principle ref. [12], *i.e.*, the shortest time to travel between the two points:

$$T_{[\min]} = \int_A^B \frac{|\mathrm{d}s|}{u_{(R)}} \tag{19}$$

As can be seen in Figure 7, the trajectory of the light beam is not straight, and it depends on the magnitude of the gravitational field through which it passes. That is, it is a gravitational curvature of the beams of light. Optically, in order to calculate the trajectory of the light motion, it can be assumed that the refractive index at level R is: $n_{(R)} = \dfrac{c}{u_{(R)}}$.

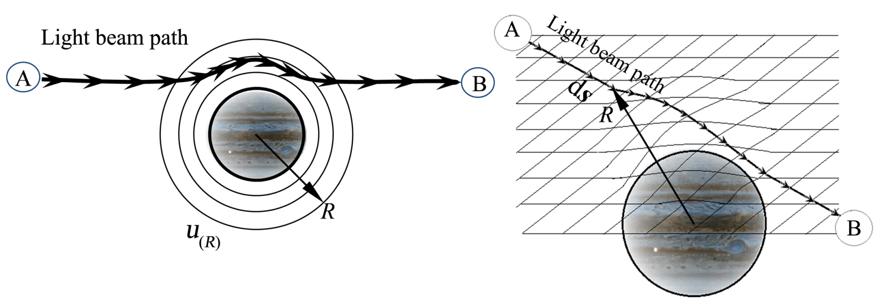

Figure 7. Description of the trajectory of a beam of light moving from point A to point B, through a gravitational field.

8. The Gravitational Force

It can be said that a gravitational field creates different energy levels, which depend directly on the distance R and the mass M of the field source. In the transition between the energy levels, force of gravity is obtained.

Force of gravity acts on a small body at **rest** under the influence of a gravitational field of a large body M, at a distance R, called the body weight, and is equal to the gradient of the potential energy: $\boldsymbol{F} = -\text{grad}E_p = -\nabla \cdot E_p$. The potential energy is actually the state kinetic energy when the body is at rest, which we calculated in Formulas (9) and (10). Therefore force of gravity will be:

$$\boldsymbol{F}_{(R)} = -\frac{\mathrm{d}E_p}{\mathrm{d}R} = -m_0\left(\frac{GM}{R^2} - 2\frac{G^2M^2}{c^2R^3}\right) \tag{20}$$

Formula (20) can also be written as follows:

$$\boldsymbol{F}_{(R)} = -m_0\frac{GM}{R^2}\left(1 - \frac{2R_0}{R}\right) \tag{21}$$

The value $R_s = 2R_0$ is the event horizon, in this case.

According to Formula (21), in the case of a black hole, we see that force of gravity becomes zero on the event horizon, and it even changes direction in the area of $R_s > R > R_0$, *i.e.*, in this area it becomes a repulsive force, as shown in Figure 8. It is important to note that very strong forces are included in these areas. It can be said that the event horizon behaves like a (bouncing) trampoline on which the body will swing.

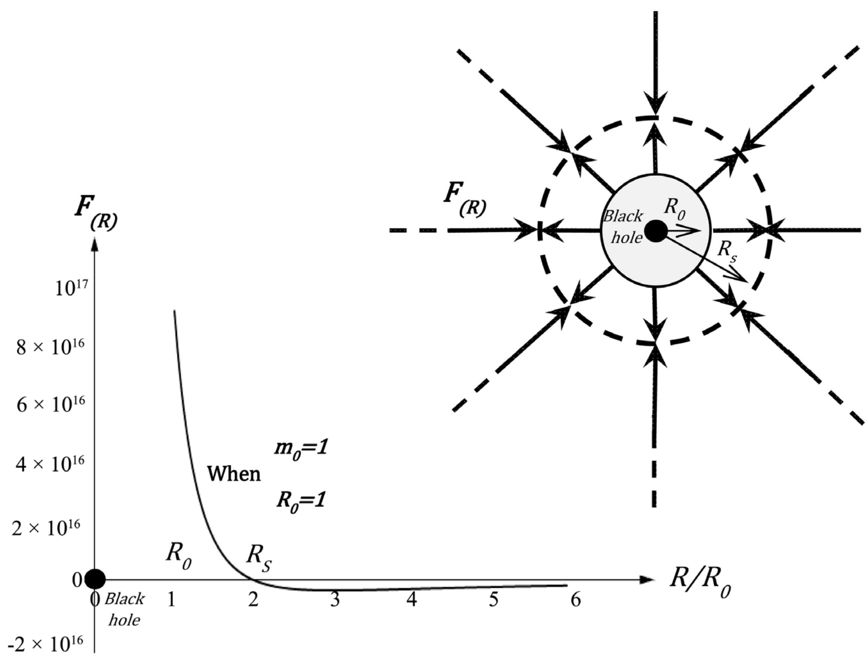

Figure 8. Description of the direction of the gravitational force in a black hole. Up to the event horizon, the force is a force of gravity, between the event horizon and the zero horizon there is a repulsive force.

For example, a body which stabilizes at the end of a process in the event horizon of a black hole. In this case, his energy is $E = m_0 u_{(R)}^2 = 0.25 m_0 c^2$. It is clear that forces acting on the body are conservative forces, so the energy difference, which is $\Delta E = 0.75 m_0 c^2$, transfers this energy to the core of the black hole. Therefore, the self-speed of light vector of the black hole core will be greater than the speed of light, since in the process of energy transfer there is no mass transfer, when the mass of the black hole core remains constant in this case. Here we got for the first time a higher velocity than the speed of light, in a limited range between $R_s > R > 0$.

9. Discussion and Summary

9.1. Discussion

We show the total energy of a small body in a gravitational field, its kinetic energy and potential energy. We show that as the body gets closer to the large body, its energy will decrease accordingly. We calculate and explain the horizon zero, the time difference between two bodies, the effective mass of the body, the gravitational force created by this change in the energy levels, and the effect of a gravitational field on the speed of light. Furthermore, we calculate its escape energy and escape velocity, showing that a body with escape velocity maintains the state kinetic energy as zero along the way until it detaches from the gravitational field effect and that the process is reversible, *i.e.*, a body approaching a gravitational field receives the same values of energies.

Later on, we show that there is a time difference between the ISS and GPS satellites, caused by a time difference two reference frames of two bodies: one is a free stationary body (without gravitational effect), and the other is a mobile body under gravitational field influence.

We continue with the calculation of the speed of light, and we show the influence of a gravitational field on it. Finally, we show that gravitational field creates different energy levels, which depend directly on the distance R and the mass M of the field source. In the transition between the energy levels, force of gravity is obtained. We reach a higher velocity than the speed of light, in a limited range between $R_s > R > 0$.

9.2. Summary

This model presents the force of gravity in a different and innovative way, thus giving answers to issues on many topics in physics that bother many scientists. From looking at a body with a large mass that forms envelopes of energy levels, this model shows that these energy levels are the reason for the formation of the gravitational force. The gravitational force, in fact, is created as a result of the transfer between the different energy levels. It is possible to refer to a single mass or to several masses (for example, a galaxy, or the entire universe) which at their center there is an imaginary mass equivalent to them. In addition, this model shows that these energy levels are also the reason for the decrease in the speed of light, resulting in time differences, which create potential gravitational energy which is accurately calculated in this model. These energy levels are also the reason for bending the movement of light that passes through the gravitational field they create.

9.3. Future Studies

This research paper is in fact a gateway to other research papers, in which we will examine additional topics, including:

1) What does the force of gravity depend on, when there are different initial conditions, for example initial velocity, or negative mass, *i.e.* a small body with a large energetic angle.

2) Is the event horizon a fixed value or does it change according to the initial conditions?

3) Does a gravitational field affect the state kinetic energy?

4) This research paper is a true theory for large bodies, such as stars and black holes, and also for tiny particles such as the various components of the atom. Therefore, a general idea can be found from it for all four known forces in physics ref. [13].

5) What are the astrophysical consequences of the self-speed of light vector and the core of gravitational mass?

Acknowledgements

R. B. G thanks always to my teacher and Rabbi Prof. Aharon Peled, as well as my thanks to Noya Epelstain.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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