Quantum and Relativistic Gravity: Understanding Potential Energy through Space Flow Kinetics

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Abstract: *This paper proposes a novel approach to gravitational potential energy, deriving it from impediments to the flow of space. Building on a previous theory, the study demonstrates that gravitational energy is sourced from interactions that prevent objects from following space flow. It further explores time dilation by recognizing kinetic and gravitational contributions, presenting an alternative to conventional negative energy interpretation. In 1760, Lagrange included a minus sign to the gravitational potential energy to compensate this misunderstanding. A time dilation due to an increment in energy is what is observed in nature, i.e., a time dilation in cell phones which makes GPS accurate. This theory based on relativistic and quantum contribution, taking a step forward in explaining the gravitational effect and posits a universe of positive energy, challenging many-world hypotheses and offering an experimental approach to test this theory considering gravitational and kinetic time dilation during free-fall.*

Keywords: gravitational energy, potential energy, time dilation, space flow, quantum gravity, theory of space

1. Introduction

In 1907, Einstein [1] had his happiest day when he developed the equivalence principle. A radical view in which gravity is equivalent to a space acceleration. Later in 1916, Karl Schwarzschild [2] [3] took a further step presenting an intuitive equivalence to an escaping speed; i.e., a simpler expression of Einstein´s general relativity for the case of a non-charged, non-rotating spherically symmetric body. Presenting a compacted mass confined to the smallest radius Rs forming an event horizon at its surface. Taking Me as the energetic mass, C as the speed of light and G as the gravitational constant; the Schwarzschild radius Rs will be as follows:

$$Rs = 2GMe/C^2 \qquad (1)$$

The escaping speed, Vs, is the minimum speed required for light (speed C) to escape a potential field from a distance of Rs. In other words, from the horizon event that contains the speed C. In a general way, at a distance R, Vr will be the minimum escaping speed from this position:

$$Vr = SQRT\ (2GMe/R) \qquad (2)$$

A time dilation at a surrounding radius R is t and t_o is the time without any presence of energy. The following equation comes from Lorentz´s time dilation:

$$\text{Ratio of } t/t_o = SQRT\ (1 - Vr^2/C^2) \qquad (3)$$
$$\text{Ratio of } t/t_o = SQRT\ (1 - Rs/R) \qquad (4)$$

This dilation was predicted by Einstein in 1907 – 1911 [4] and was first confirmed by the Pound-Rebka experiment in 1959 [5] observing the gravitational redshift effect. Another confirmation was done by Alley *et al.* in 1975 [6] by comparing atomic clocks at Earth with the others in a patrol plane flowing in a "racetrack" path over Chesapeake Bay (results in Figure 1). A remarkable exactitude combining kinetic speed with gravitational effect, i.e., special relativity with general relativity (Schwarzschild solution).
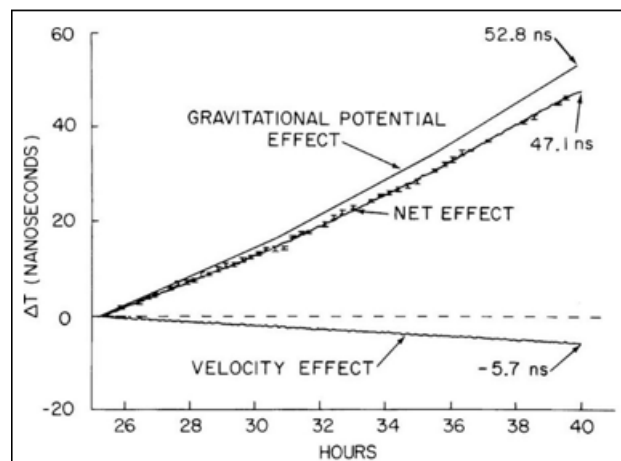

Figure 1: Figure 43 from reference [6]

2. Conservation of energy in inertial frames

Before doing further analysis, let's see what happens with the energy content if it is seen under different inertial frames of reference. As shown by the author in a previous paper [7], energy is conserved for all these inertial frames. The observed speed value and the observed mass-energy value change depending on the inertial frame selected, but not its total energy. Consequently, its gravitational attraction won´t change because its total energy hasn´t changed (General relativity). Figure 2 shows how to understand this; note that in the horizontal axis is the observed mass-energy Mo and not necessarily mass at rest. Take Figure 2 A and change the angle of the triangle, which changes the observed speed Vo from different frames of reference but not the total energy (constant hypotenuse Eo). Also, note that Eo can be expressed as proper mass Mp multiplied by C square. This will give one of Einstein's famous equations.

$$(Eo)^2 = (MpC^2)^2 = (MpVoC)^2 + (MoC^2)^2 \qquad (5)$$

Observe that Mass at rest can be obtained when the proper mass value is always incremented when a velocity is introduced in any direction, i.e., it is at the maximum

observable mass (Eo at the horizontal axis in Figure 2 A). Besides, the condition of no gravitational field is present.

Meanwhile, in Figure 2 B, kinetic energy is incremented to the mass-energy, consequently, E1 will be greater than the previous energy Eo. Lately, any inertial frame of reference will observe a particular mass and speed regarding the previous case of Figure 2 A.

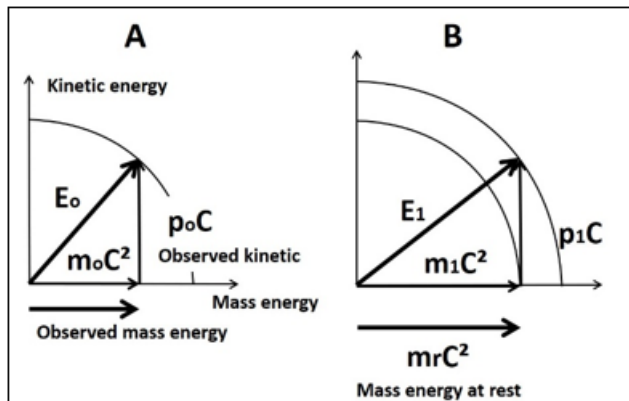$$(E1)^2 = (MpC^2)^2 = (MpV1C)^2 + (MrC^2)^2 \quad (6)$$

Figure 2

From the previous paper of the author [8], the mass-energy is understood as the kinetic between the 3D and its 4th dimension. Determining that the mass-energy is also a type of kinetic energy (orthogonal to 3D), i.e., at the 4th dimension. For that reason, they must be added as vectors (Pythagoras formula) and not as scalars. This important fact is used during the analysis.

3. Time dilation in inertial frames and accelerated ones

Using the equations of special relativity and Planck´s quantum equation, Figure 3 shows how time dilation is obtained in the triangle when its hypotenuse is equal to one. Here, the "o" means observed and the "p" means proper. It shows the time dilation variation regarding any initial condition and not necessarily from mass at rest.

Now let´s see what is implicit in the Schwarzschild proposition when a gravitational field is present (non-charged, non-rotating and spherically symmetric energetic mass Me). The minimum kinetic energy required for escaping the gravitational field EQUALS the potential field multiplied by minus one. Note that the potential energy very far from the energetic source equals zero, i.e., nothing present. That is the reason why potential fields have a negative value; the only explanation of how energy is PROVIDED when they get stationarily closer to the energetic source. A partial negative energy is understandable but, is it possible to have a total negative energy on its own? **Even more, Lorentz´s time dilation is deduced under the basis of acquiring kinetic energy; so, how a negative energy produce the same dilation instead of a "time contraction?"** This paper proposes that the energy comes from the impediment to follow the flow of space towards the energetic source, and this impediment contains a positive value.
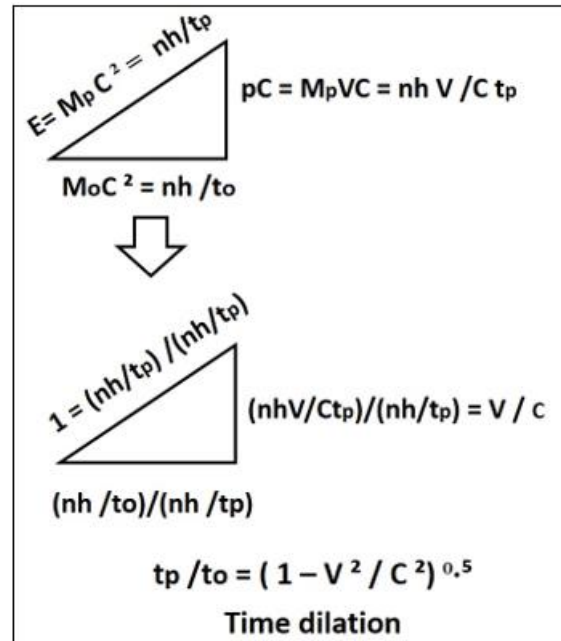

Figure 3

One type of impediment is from collisions between particles that can´t share the same space. For example, when a free-falling ball hits the ground, it receives energy from the impact. Another example is when water free-falls from some altitude and reaches (impacts), at a lower position, the blades of the electric generator. The angular deviation of the moving water supplies the energy to spin the turbine.

Another type of impediment is the pulling upward action avoiding objects to follow the flow of space. Like in pendulums, where the string pulls constantly upwards producing a kinetic speed that counteracts the speed increment of the falling space; i.e., an upward event regarding to the space flow.

Another example is the pushing from below to achieve the same effect as seen in Archimedes´ principle. In another case, when the spaceship´s engine returns to Earth, the energy from the combustion produces a soft landing.

There is no impediment when objects have a convenient orthogonal speed concerning the space flow. Their continuous falling action together with the orthogonal speed, describes a curved trajectory around the energetic source. Like the trajectory of planets around a massive energetic source, i.e., the solar system among other systems. They don´t constantly acquire more energy when changing their position (more time dilations), they simply maintain their energy in a stable orbital path.

All this reasoning is in agreement with Einstein´s equivalence principle; the falling man doesn´t experience any acceleration/gravity. This implies that the falling man doesn´t acquire any energy (no acceleration). He just follows the flow of his space, with no speed increment regarding its space; i.e., no acceleration and no time dilation.
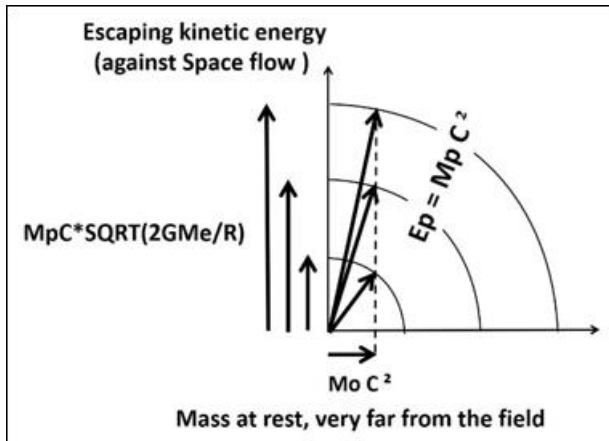
Figure 4

In a general way, objects follow their space, even when their space increments their speed towards the energetic source. If the object is stable at a certain distance R from the source, it means that it has acquired a kinetic energy regarding to its flowing space; i.e., the Schwarzschild escaping speed. Figure 4 expresses the different space flow (with a minus sign), a value that follows the SQRT (1/R). The total energy of stable objects is increased when they get closer to the energetic source. At a given distance R, the vectorial addition of its mass-energy plus its relative kinetic speed Vr is:

$$MpC^2 = SQRT((MoC^2)^2 + (MpVrC)^2) \qquad (7)$$
$$MpC^2 = SQRT((MoC^2)^2 + (MpC)^2*(2GMe/R) \qquad (8)$$
$$Mo/Mp = SQRT (1 - 2GMe/C^2R) \qquad (9)$$

From equation 1 and replacing MpC² for Planck´s n*h/tp; idem with MoC² for n*h/to, then Schwarzschild´s time dilation is obtained.

$$tp/to = SQRT (1 - Rs/R) \qquad (10)$$

A time dilation product of an increment of energy. In 1760, Lagrange developed a different way, from Newtonian mechanics, to calculate the evolution of objects. He took energy into account considering kinetic energy MINUS gravitational potential energy. He needed to do that because of the misunderstood negative potential energy. In other words, he adds both energies.

Some examples for clarifying this concept: a free-falling man from outer space will see the clocks of the first atom in our atmosphere, clicking a little slower. During his fall, he will appreciate a progressive decrement in the clocks of the atmospheric balloons, the birds and finally the people´s clock on the ground. Note that those entities have gained kinetic energy regarding their space that is flowing with the man. The energy acquired for those stable R positions is what gives a time dilation concerning the falling man that maintains its total energy.

The concept of proper time that manages that situation is understood by this theory of space [7]. All the clocks are subject to the universal passage of time, the difference is in the graduation of their dial, some values are more separated than others; i.e., the separated ones corresponding to the time dilation of the previous paragraph. Note that the handle of all clocks is synchronized to the "now" concept. Whatever the value of each individual clock has, its handle points to the universal "now." **This is the way to understand simultaneity.** A unique event in "now" meanwhile, each clock is subject to its proper value tp; simultaneity doesn´t mean having the same value of time.

Photons at speed C have a delta t equal to zero, this doesn´t mean that they are at all instances, "at eternal now's." Their clock handle will go along with the other clocks in the universal passage of time. The peculiarity is that its dial contains the same value all around, so, the time difference between one "now" and another subsequence "now" is zero.

In another case, the satellites of the GPS have a proper value; opportunely understood thanks to Einstein´s inside. That difference doesn't affect sharing, at the same instance the information with all the cell phones and GPS systems on Earth´s ground (discounting signal traveling time). Even more, if they get some onboard maintenance, the astronaut that arrives recently from Earth will be in the same "now" with the satellite that, at that moment, will contain a significant accumulation of time dilation.

4. Gravitational speed and observable speed

From the space perspective, the relativistic addition of velocity Vr plus the extra upward velocity Vz of the object from the stationary distance R is:

$$Vrz = (Vr + Vz) / (1 + VrVz/C^2) \qquad (11)$$

Figure 5, the final total energy (MpC²) will be:

$$(MpC^2)^2 = (MpC (Vr+ Vz)/ (1 + VrVz/C^2))^2 + (MpCVxy)^2 + (MrC^2)^2 \qquad (12)$$

$$Mo/Mp = SQRT (1- (Vxy/C)^2) - \{(Vz + Vr)/ (C + VzVr/C)\}^2) \qquad (13)$$

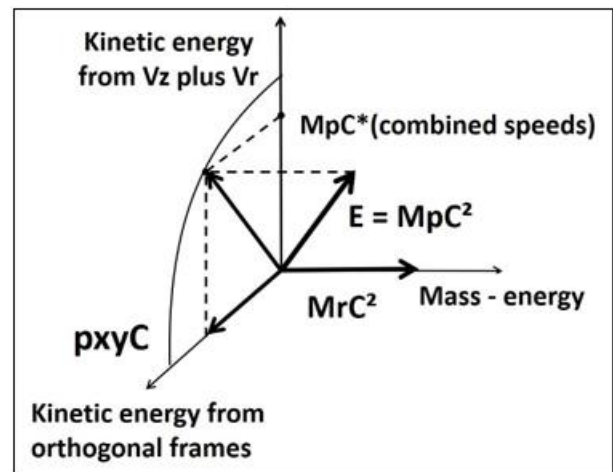**Figure 5**

As previously, from equation 2 and replacing MoC² by n*h/to and MpC² by n*h/tp we obtain:

$$tp/to = SQRT (1- (Vxy/C)^2 - (Vz + SQRT[2GMe/R])^2 / (C + Vz SQRT [2GMe/R]/C)^2) \qquad (14)$$

A combined time dilation from relativistic and gravitational effects. At no relativistic speed of Vz and Vr, the equation will be:

$$tp/to = SQRT (1- (Vxy/C)^2 - (Vz/C + SQRT[Rs/R])^2) \qquad (15)$$

When Vxy equals zero and Vz equals minus Vr, then the object is in free fall and no time dilation is perceived during the fall:

$$tp/to = SQRT (1 – 0^2 – 0/ (1 – Rs/R)^2 = 1 \quad (16)$$

5. Theory of space, the 4ᵗʰ D and gravity

It´s convenient to review some of the core aspects of the Theory of Space proposed by the author [8]. The 4ᵗʰ dimension is iCtau where the time tau is the "time" in the core of quantum mechanics that is multiplied by C, expressing energy´s wavelength (4ᵗʰ D). In other words, the periodic time involved in Planck´s first quantum equation (E = h/tau). Not Minkowski´s time of events which is for another type of analysis. Aside from the issue that Minkowski´s time depends on its initial time. Meanwhile, Planck´s time depends on the energetic content, which deals with the gravitational effect. Energy is the one that produces gravity as first expressed by Einstein in his General Relativity equation; space on one side of the equation and the energy tensor on the other side. This is the reason why MC² and kinetic speed of previous equations are replaced with the periodic Planck´s time; a simple way that induces the proper time is these equations.

Another aspect of this novel theory is that space itself is moving toward the energetic bodies. Not only Einstein´s equivalence acceleration but a real movement of space. In the case of a non-rating, spherically symmetric body, the speed of this space flow will be the negative value of Schwarzschild´s escaping speed. So, if some compact entity is "floating" in its space and this space is progressively changing its speed, then the compact particle will go along with this change. If not, it will have a change in the speed between it and its space, and for that, it will require some force (first law of motion). In other words, from the particle´s perspective, it will follow and not feel this change of speed; identical to Einstein´s thought of the free-falling man, no gravity felt. Consequently, it will not receive any change in its energy content along its trajectory toward the energetic source because there is no acceleration or force present. The total energy is conserved.

Since the theory deals with an intermittent presence in 3D at the rate of Planck´s periodic time, the quantum system is getting in-and -out 3D. Each time that it leaves the 3D its space also leaves and is replaced by the surrounding space. This is the reason how energy creates the space flow, i.e., gravity from a quantum explanation. So, this flow of space has an intermittent origin at this quantum scale, it is related to the volume of the quantum system and its energetic frequency. It depends on the system volume and not on the exact position of the particles in the system. When the quantum system is split, the absorption effect is done by both parts despite the fleeting quantum jumps that the particle does between both parts.

The mass-energy orthogonal to the 3D kinetic energy is understood as the kinetic of this oscillation between 3D and the 4ᵗʰ dimension [9]. It isn´t a different type of energy that will add as scalars; it needs to be considered as a vectorial addition.

6. An interesting experiment

Equation 16 is testable and can verify if the gravitational effect is part of a kinetic movement or if they are two separate effects. Two separated groups of synchronized atomic clocks can be sent vertically to the stratosphere. When they reach about 200,000 km from Earth´s mean sea level with no more vertical speed, they will be divided maintaining one group at that height and the other group slightly released toward Earth. The time dilation between them can be recorded and compared while the second group travels at free-fall through the vacuum before they reach the atmospheric zone, i.e., from 20,000 km to 100 km. Note that the Moon is about 384,000 km from our Earth and the test can be done when the Moon is at the other side of the experiment. That will provide sufficient time to have some nanoseconds difference. The incrementing speed of the sets of clocks at free-fall plus the gravitational effect of being nearer Earth, will provide or won´t provide a time dilation? It is like equation 16 or equation 17 which reflects two types of energies acting separately.

$$tp/to = SQRT (1– (Vxy/C)^2 – (Vz/C)^2 - Rs/R) \quad (17)$$

7. Conclusions

This paper aims to redefine gravitational potential energy by examining it as a product of space flow impediments, contributing a new understanding of how gravitational fields provides energy and its consequent time dilation. In this way, Lagrangian mechanics is understood as an addition of positive energies, a special case of the Hamiltonian mechanics.

It also proposes a universe governed by total positive energy challenging the many worlds theory which is based on universes with a net worth of zero energy.

Schwarzschild equivalence escaping speed is changed to a relative movement of space due to the presence of energy. Where the change of speed, is the acceleration that corresponds to the gravitational effect. A step forward to Einstein´s equivalence principle and to Schwarzschild equivalence speed.

When distance R is near Rs, the Newtonian gravitational attraction requires the inclusion of gamma factor to the gravitational constant G. For this reason, the gravitational law will differ from the Coulomb law of electrostatics.

At quantum scale, this flow of space has an intermittent behavior that depends on the volume of the quantum system and its energetic frequency. It does not depend on the exact position of the particles in the system because gravity is a phenomenon of space flow. When the quantum system is split, the absorption effect is done by both parts despite the fleeting quantum jumps that the particle does between both parts [10], i.e., a revolutionary quantum gravity.

Since this theory of space deals with the space flow towards the energetic source, the Michelson – Morley experiment [11] isn´t conclusive. But thanks to it, special relativity was proposed and consequently E = MC². Michelson and Morley based their analysis on a uniform luminiferous aether or an

aether wind concept. It was thought that two measurements at different locations of Earth in the solar system would provide evidence of a relative motion concerning this old aether concept. It wasn´t conceived for an aether flowing radially toward the massive Earth, a flow that doesn´t change with the Earth´s position in the solar system.

Galaxies with huge rotating black holes were studied by Roy Kerr in 1963 [12]. But still, now, the spiral form of many galaxies is not fully understood and gives rise to considerations as dark matter. A circular and concentric motion of the space-flow combined with its flow towards the energetic sources can explain this effect. In other words, the celestial body's obtaining a "drag" from the spiral flow of space due to spinning gravitational attraction will clarify the unexplainable observation. An important fact that, for many people, involves the dark matter concept.

Note that IF the energetic source is a massive huge plane surface, then the space will move uniformly without changing its speed and no acceleration will be perceived, i.e., no gravity present in flat worlds, only a time dilation due to the uniform flow. A local energetic source in a 3D space is what generates the acceleration of this incompressible space. When space travels toward the energetic source, the surrounding area of action is reduced by the factor of $1/R^2$ producing an increment to its flow (acceleration); the same factor that Newton took into account. So, the presence of gravity implies that Earth isn´t flat. Flat-Earthers believer's experience is not being floating, even more, they are subject to an "accelerated falling space" that "drags" them to the ground.

This novel theory of space considers special relativity concepts with quantum mechanics one; a joining point between these two core modern theories. It provides a simple model for quantum mechanics by considering intermittent presence in 3D solving the measurement problem. An almost superposition of eigenstates also solves some philosophical questions regarding quantum mechanics. There is no need for the collapse of the wavefunction or the creation of infinite worlds.

Declarations

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

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