Proposal of a Time Theory

Javier Viaña

A new formula has been developed that determines the passage of time. In the paper, this is particularized for cases of temporary dilation due to speed and gravity.

Additionally, using the previous equation, an interpretation of the nature of black holes, their formation, growth, and dimension can be developed.

Moreover, and based on all of the above, a different way of understanding mass and space is proposed. Which ultimately implies an alternative expression that relates mass and energy.

I. INTRODUCTION

Relativity has contributed with a perspective of space and time that has marked a stage in the knowledge of the human being. This article proposes a theory that starts from known relativistic physics. However, it obtains theoretical results that may, to some extent, complement the understanding of time.

A theory whose objective is none other than to offer an idea to the scientific community, so that it helps in the understanding of the laws that govern the universe in which we all live.

II. THE TIME EQUATION

According to Albert Einstein [1], time passes differently for an object that travels at a certain speed v than for one that has no motion. Following equation (1),

$$T' = T\,\frac{1}{\sqrt{1-\frac{v^2}{c^2}}} \tag{1}$$

The previous expression can be rewritten as follows,

$$\frac{T}{T'} = \sqrt{1-\frac{v^2}{c^2}} \tag{2}$$

The derivative with respect to time T on both sides of the equation is considered,

$$\frac{d}{dT}\left(\frac{T}{T'}\right) = \frac{d}{dT}\left(\sqrt{1-\frac{v^2}{c^2}}\right) \tag{3}$$

T has been chosen for the derivation, since it has the same reference with respect to which v is measured. Thus,

$$\frac{dv}{dT} = a \tag{4}$$

Being a the acceleration of the particle. Solving in (3),

$$\frac{d}{dT}\left(\frac{T}{T'}\right) = \frac{1}{2}\frac{-\frac{2va}{c^2}}{\sqrt{1-\frac{v^2}{c^2}}} \tag{5}$$

$$\int \sqrt{1-\frac{v^2}{c^2}}\; d\left(\frac{T}{T'}\right) = \int -\frac{va}{c^2}\,dT \tag{6}$$

Multiplying and dividing to the right of the equation by the mass m, and substituting the factor $\sqrt{1-\frac{v^2}{c^2}}$,

$$\int \frac{T}{T'}\; d\left(\frac{T}{T'}\right) = \int -\frac{mva}{mc^2}\,dT \tag{7}$$

Applying the knowledge of Newtonian physics,

$$F = m\,a \tag{8}$$

$$P = F\,v \tag{9}$$

Where F is the force applied to the particle (it does not necessarily need to exist, but for the demonstration it is considered), and P its power.

$$\int \frac{T}{T'}\; d\left(\frac{T}{T'}\right) = \int -\frac{P}{mc^2}\,dT \tag{10}$$

On the other hand, energy E is defined as,

$$E = \int P\,dT \tag{11}$$

Putting everything together and integrating on both sides,

$$\frac{1}{2}\left(\frac{T}{T'}\right)^2 = k - \frac{E}{mc^2} \tag{12}$$

Being k the constant of integration. In the present theory, ε is defined as the specific energy of the particle,

$$\varepsilon = \frac{E}{m} \tag{13}$$

The value of $\frac{1}{2}$ to k will be assigned. In more advanced sections of the article it will be seen how having such value and particularizing for known cases, the expected results are obtained. Finally,

$$T' = T \frac{1}{\sqrt{1 - \frac{\varepsilon}{c^2/2}}} \tag{14}$$

This equation constitutes one of the pillars of this theory. The method for deduction may be somewhat doubtful, since nothing else has been done apart from derivating and integrating. However, along the way, it has been possible to find a new interpretation of time as deep as it is simple. An equation whose statement reads: "The advance of time depends on the specific relative energy." Understanding "relative" energy of a **mass** A as that which arises taking as reference a **point** B in space. B being the origin of zero potential according to the type of each energy. This article will talk about ε or $\varepsilon_{A_{r_B}}$ indifferently. To calculate $\varepsilon_{A_{r_B}}$ it will be necessary to divide the total energy of mass A by m_A.

$$\varepsilon_{A_{r_B}} = \frac{E_{Tot}|_{Ref\ B}}{m_A} \tag{15}$$

If the equation (14) is correct, its significance can be tremendous. It would provide an understanding of the time that until now has been unknown, a key to unveil many of the mysteries of the universe that still resist the predictions of modern physics.

One of the peculiarities of this is the energy limit. No mass or particle can exceed the specific energy limit $\frac{c^2}{2}$. Since if exceeded, the result of time would be a complex, unreal, non-existent number.

The formula (14) proposed in this theory concerns both the Theory of Special Relativity and the Theory of General Relativity, Ref. [1], [2] and [3]. The Theory of Special Relativity has among many other conclusions the equation (1) with which the demonstration of the present theory has begun. Since it is the starting point of equation (14), it should also be able to predict the behavior of (1). Following the definition of ε and specifying for this case, in which A has as its only energy the kinetic energy due to v,

$$\varepsilon = \varepsilon_{A_{r_B}} = \frac{E_{A_{r_B}}}{m_A} = \frac{\frac{1}{2}\, m_A \left(v_{A_{r_B}}\right)^2}{m_A} = \frac{\frac{1}{2}\, m_A v^2}{m_A} = \frac{v^2}{2} \tag{16}$$

Inserting in (14) it can be seen how that the result obtained is the same as (1).

Moving to the Theory of General Relativity, similarly, it is reached a different formula that defines time as,

$$T' = T \frac{1}{\sqrt{1 - \frac{2GM}{R\, c^2}}} \tag{17}$$

However, the formula speaks of the temporal dilation due to the gravity of a mass, not the dilation due to the velocity of the particle. In this case, A is a mass without velocity. Separated a distance R from point B. Nevertheless, so that A is attracted to B, a mass M has been placed at point B, which will be the origin of the gravitational field. Rephrasing the expression of ε for this situation,

$$\varepsilon = \varepsilon_{A_{r_B}} = \frac{E_{A_{r_B}}}{m_A} = \frac{m_A\, g\, R}{m_A} = g\, R = \frac{GM}{R^2}\, R = \frac{GM}{R} \tag{18}$$

Inserting in (14) it is again verified that the result is the same as that predicted in (17). To some extent, equation (14) unifies (1) and (17) under the same interpretation of time.

III. THE NATURE OF THE BLACK HOLES

As it is known, these phenomena have an event horizon, surface on which time does not pass. Starting from this understanding, if the time-pass is null, then applying (14), and taking as reference the center of mass of the black hole, it is obtained that,

$$\varepsilon = \frac{c^2}{2} \tag{19}$$

That is, the specific energy of a mass located in the event horizon with respect to the center of the hole is $\frac{c^2}{2}$.

The mass m must travel through a specific path to reach the event horizon. Assuming a straight path, the particle has to go through 5 positions of interest until it reaches the surface.

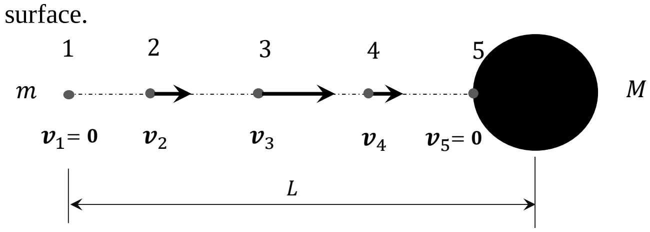

FIG 1. Velocity states of mass m in the approach to a black hole

Initially the particle is at rest in position 1, separated a distance L from the center of the hole. Due to the attraction of the hole, the particle begins to advance, reaching position 2 with a velocity v_2. Its speed increases, until it reaches 3. In 3 the particle has both, the energy due to the attraction of the hole and the kinetic energy $\frac{1}{2}\, m\, {v_3}^2$. However, when calculating ε at 3, it is observed that its specific energy is $\frac{c^2}{2}$, the maximum that can be had. Between 3 and 5 the particle has at all times an ε of $\frac{c^2}{2}$, and as its potential energy increases, the kinetics must decrease,

$$v_2 < v_3 > v_4 \tag{20}$$

Once it reaches 5, the velocity becomes null and the particle is trapped on the surface, unable to advance further, since that would imply that $\varepsilon > \frac{c^2}{2}$, contradicting the principle described in the first section.

It is known that matter approaching the black hole decelerates. The belief of the current era attributes this phenomenon to the fact that the closer to the hole, the greater its speed but the slower its passage of time. Hence the feeling of deceleration.

But since the outer reference observes the particle travelling with its v, it must be this variable the one that has to be reduced so that the observer sees it travelling more slowly. The above explanation solves this.

Then, if the particle reaches the surface with zero velocity but its ε is $\frac{c^2}{2}$, it cannot continue advancing. That particle becomes part of a thin crust, of a spherical armor that covers the black hole. But what is inside the black hole?

As said, nothing can be closer to the center of the hole's radius. Therefore, there can be nothing inside. Nothing but what was already when the hole formed.

To answer what was inside when it was created, it is necessary to ask another question before. What is the origin of a black hole?

In the death of a star, the supernova can degenerate into a neutron star or a black hole. It is in the supernova itself where the key is. If during the brutal explosion, a certain point of the star reaches a specific energy equal to $\frac{c^2}{2}$, then this particle, or set of particles, forms the shell of the black hole, the initial seed.

However, the matter that is closer to the particle whose internal energy has reached $\frac{c^2}{2}$ is forced to move away at high speed. That is why an explosion occurs. Due to the fact that the energy limit cannot be exceeded at any point. Even the matter that constitutes the initial particle itself suffers this effect, thus moving away from its center of gravity, dispersing. Until at a certain distance, the process reaches the balance. That is when the shell forms. A hollow wrapper that grows without any particles lagging behind in the path. Leaving in the center a space without matter, a thin skin inside which there is absolutely nothing. That is, as understood by the author, the nature of a black "hole."

Now, a particle of our universe can have a specific energy of $\frac{c^2}{2}$ without creating a black hole. Light for example has this ε. The essential difference for this phenomenon to form is the reference point.

In the extreme case where the ε of a particle A has its own center of mass as a reference, that particle is trapped in itself. It has the maximum specific energy possible to reach the place where it is already. The author understands that only in this way the formation of the black hole is possible. Retaining the first particle in its own cell.

To this specific energy term whose reference is in its own center of mass, the name of specific internal energy can be attributed.

Once it has been created, little by little, other masses fall into its event horizon, growing the hole.
Its center of mass is geometrically in the center, but all its mass is scattered in the crust.

This fits with current theories. For example, the equation that determines the entropy of the black hole, which depends on the area of its surface, not on the volume that contains, Ref. [4] and [5]. When in our world entropy usually depends on volume.

That is why it leads us to think that the entire mass of the black hole is only on its surface.

Next, the radius of a type of black hole will be calculated using the formula proposed in this theory. For this, the center of mass of the hole will be taken again as the reference point. In this study, ε will refer to a mass m located in the event horizon, and therefore its ε will be equal to $\frac{c^2}{2}$, since time does not pass for a mass located in that place.

The Schwarzschild's Black Hole is characterized by having neither rotation nor charge, only mass. Then all the specific energy will be gravitational. Applying the above, being g the gravity, M the mass of the hole, G the gravitational constant, R the radius of the black hole and in turn the distance that separates the particle from the center,

$$\frac{c^2}{2} = \varepsilon \tag{21}$$

$$\frac{c^2}{2} = \frac{1}{m}\, m\, g\, R \tag{22}$$

$$\frac{c^2}{2} = \frac{G\, M}{R^2}\, R \tag{23}$$

$$R = \frac{2\, G\, M}{c^2} \tag{24}$$

Surprisingly, this value fits with the well-known Schwarzschild radius, Ref. [6].

The radii of the other three types of known black holes (Kerr, Reissner-Nördstrom y Kerr-Newman) are elaborated in detail in Ref. [7], where the veracity of naked singularities is also discussed.

IV. TRANSFORMATIONS

This section aims to rewrite the relativistic variables based on the formula (14) proposed. To do this, a simple reasoning is used that substantially speeds up the deduction. By grouping (14), the equation can be understood as,

$$T' = T\,\frac{1}{\sqrt{1-\frac{\left(\sqrt{2\,\varepsilon}\right)^2}{c^2}}} \tag{25}$$

Comparing with (1) it follows that,

$$v = \sqrt{2\,\varepsilon} \tag{26}$$

This does not mean that the specific energy of the mass is entirely kinetic,

$$\varepsilon \neq \frac{1}{2}\,v^2 \tag{27}$$

No, in fact, it does not need to have specific kinetic energy (as it has happened in the black hole equations). The v only represents the variable that will be replaced by $\sqrt{2\,\varepsilon}$. The theoretical development for the calculation of relativistic mass and length is analogous to those known today, except that instead of having a velocity v it is $\sqrt{2\,\varepsilon}$. Therefore,

$$m = \frac{m_0}{\sqrt{1-\frac{\varepsilon}{c^2/2}}} \tag{28}$$

$$L = L_0\sqrt{1-\frac{\varepsilon}{c^2/2}} \tag{29}$$

Being m and L the values of mass and relativistic length, m_0 and L_0 the values of mass and length without specific energy.

To some extent, $\sqrt{1-\frac{\varepsilon}{c^2/2}}$ has been understood as a factor that generalizes different energy contributions, not just gravitational and kinetic. But in addition, it is observed that it can continue to be applied to particles without mass. Since with the use of specific energy, mass is taken out of the equation, concentrating the application of the formula at an infinitesimal and specific point of the study particle.

V. MASS AND ENERGY

This section is probably the most difficult to explain. Here is explained why the equation proposed by Albert Einstein, Ref. [8], based on all the above described, may not be correct.

It is known, however, that this equation has predicted reality very precisely. Proof of this is the use we have made of nuclear energy on the planet. However, the experimental results have always differed minimally from the theoretical prediction.

It is accurate under very specific conditions. It is not exact, and in some cases, it presents an infinite error.

Supposing a set consisting of three masses, m_1, m_2 and m_3,

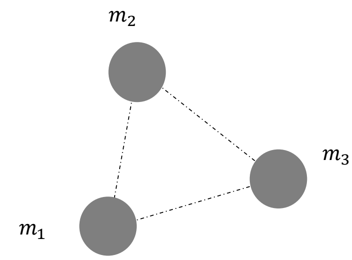

FIG 2. Set formed by three masses, m_1, m_2 and m_3

The theory proposed in Ref. [8] explains an excess of mass when the parts (m_1, m_2 and m_3) are joined, or together, by the effect of the bonding energy. This energy that keeps them tied will be called E. Includes kinetic, potential, thermal, etc.

The excess (or defect) of mass (m_{extra}) can be visualized by,

$$m_{Total} = m_1 + m_2 + m_3 + m_{extra} \tag{30}$$

Defining the reference without energy as,

$$m_0 = m_1 + m_2 + m_3 \tag{31}$$

Then,

$$m_{Total} = m_0 + m_{extra} \tag{32}$$

As it is known,

$$E = m_{extra}\,c^2 \tag{33}$$

Expressed in a different form,

$$E = (\,m_{Total} - m_0\,)\,c^2 \tag{34}$$

Below is calculated the specific energy of the set relative to its center of mass. To do this, it must be divided by the mass m_{Tot},

$$\varepsilon = \frac{E}{m_{Tot}} = \frac{m_{Total} - m_0}{m_{Tot}}\;c^2 \tag{35}$$

$$\varepsilon = \left(1-\frac{m_0}{m_{Tot}}\right)c^2 \tag{36}$$

As seen in the previous section, the mass is conditioned by the ε according to equation (28),

$$\frac{m_{Tot}}{m_0} = \frac{1}{\sqrt{1-\frac{\varepsilon}{c^2/2}}} \tag{37}$$

Equations (36) and (37) are the mass – specific energy relationships according to Albert Einstein, and according to the author of the present theory, respectively. However, it is observed that they are not equal. One of them is not correct. This can be observed by substituting one into another, since such substitution should lead to an equality.

$$\frac{m_{Tot}}{m_0} = \frac{1}{\sqrt{2\,\frac{m_0}{m_{Tot}}-1}} \tag{38}$$

Calling y the quotient of $\frac{m_0}{m_{Tot}}$,

$$\frac{1}{y} = \frac{1}{\sqrt{2\,y-1}} \tag{39}$$

Simplifications end in two functions, one on the left of equality and one on the right,

$$f_1 = \frac{1}{y} \tag{40}$$

$$f_2 = \frac{1}{\sqrt{2\,y-1}} \tag{41}$$

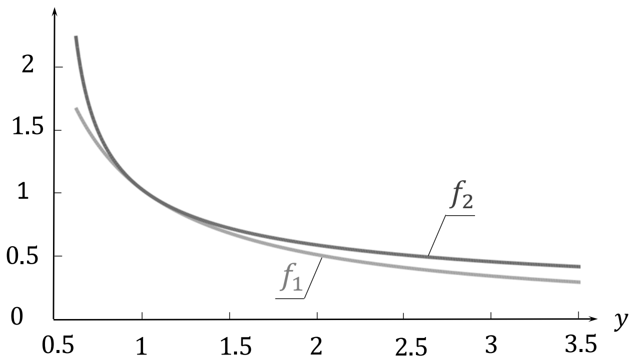

FIG 3. Tangency of functions f_1 y f_2

Both functions are tangent at the point where y is equal 1. It is thus observed that for those values close to 1, the error incurred is very small, while when being far from 1, the error can be very high.

In other words, when m_{Tot} and m_0 are similar (usual in small masses), both theories are applicable. This is why the author believes that we have not been able to see significant errors in the measurements of the experiments performed. Because all measurements have been made for cases of tiny values of m_{extra}.

In fact, this is the reason why the author believes that (32) and (33) are not correct. Both are included, because together they form a system of two equations that gives each one a sense of interpretation. Formula (33) without (32) is meaningless.

Maybe for this point in the reading, there are those who say that the mass is preserved and that m_{Total} must be equal to the sum of $m_0 + m_{extra}$. The author is not against the principle of conservation of mass. But the m_{Total} follows a deep mathematics, more complex than the sum of the parts that compose it.

To obtain the correction proposed by this book of the equation $E = m\,c^2$, equation (37) will be used,

$$\frac{m_{Tot}}{m_0} = \frac{1}{\sqrt{1 - \frac{E}{m_{Tot}\ c^2/2}}} \tag{42}$$

$$1 - \frac{E}{m_{Tot}\ c^2/2} = \left(\frac{m_0}{m_{Tot}}\right)^2 \tag{43}$$

$$E = m_{Tot}\ \frac{c^2}{2}\left(1 - \left(\frac{m_0}{m_{Tot}}\right)^2\right) \tag{44}$$

$$E = \frac{c^2}{2}\left(m_{Tot} - \frac{{m_0}^2}{m_{Tot}}\right) \tag{45}$$

This equation (45) is the one that relates mass and energy. That in the background is exactly the same as (37), but allows the calculation of the energy of the link of the parts, known m_0 y m_{Tot}.

Let's study the differences between (34) and (45). To do this, m_0 y m_{Tot} will be taken as independent variables.

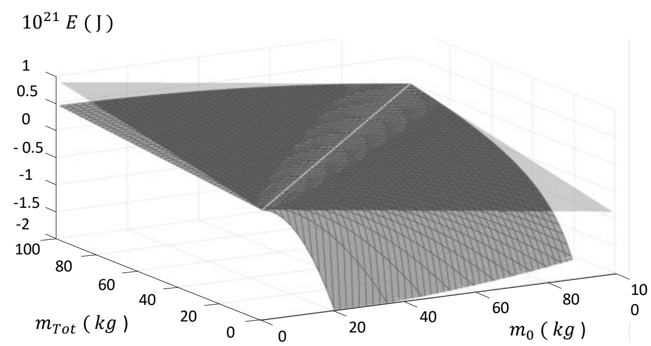

FIG 4. Differences between equations (34) and (45)

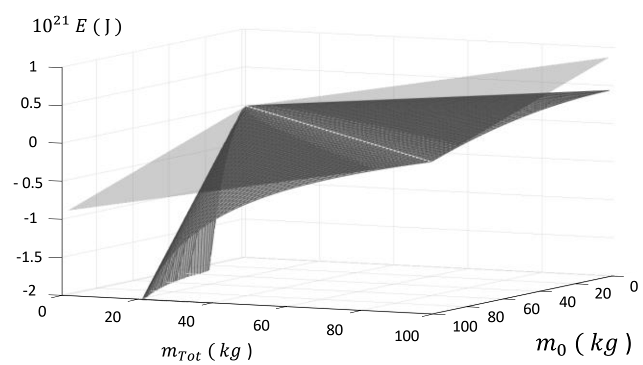

FIG 5. Differences between equations (34) and (45)

These representations are of vital importance. The plane represents equation (34) while the curved surface refers to equation (45).

This visualization shows where (34) provides the exact value of the energy when m_0 and m_{Tot} are equal, and therefore $E = 0$. In the immediate vicinity of this line, (34) is a good approximation of the suggested solution. But when leaving the adjoining margin, the errors become much more noticeable, even reaching infinitely different values.

Interestingly, the plane defined by (34) is tangent to the curved surface (45). In fact, it is tangent along the entire line $E = 0$. An uncommon beautiful relationship, between both equations.

In fact, both surfaces predict a negative energy in case $m_0 > m_{Tot}$, positive when $m_0 < m_{Tot}$ and null in case the masses are equal, as explained.

The following shows how the plane is tangent, across the straight line, to the curved surface. The equation of the plane tangent to a given point P of a function F is,

$$F_x|_P(x - x_P) + F_y|_p(y - y_P) + F_z|_P(z - z_P) = 0 \quad (46)$$

Being F,

$$F = E - \frac{c^2}{2}\left(m_{Tot} - \frac{{m_0}^2}{m_{Tot}}\right) = 0 \quad (47)$$

Renaming with x, y, z,

$$F = z - \frac{c^2}{2}\left(y - \frac{x^2}{y}\right) = 0 \quad (48)$$

Being the point P any point belonging to the line $m_0 = m_{Tot}$, thus $P(m, m, 0)$. Calculating the partial derivatives,

$$F_x = -\frac{c^2}{2}\left(-\frac{2\,x}{y}\right) \quad (49)$$

$$F_y = -\frac{c^2}{2}\left(1 + \frac{x^2}{y^2}\right) \quad (50)$$

$$F_x = 1 \quad (51)$$

Substituting P it is obtained,

$$F_x|_P = -\frac{c^2}{2}\left(-\frac{2\,m}{m}\right) = c^2 \quad (52)$$

$$F_y|_P = -\frac{c^2}{2}\left(1 + \frac{m^2}{m^2}\right) = -c^2 \quad (53)$$

$$F_z|_P = 1 \quad (54)$$

Finally,

$$c^2\,(m_0 - m) - c^2\,(m_{Tot} - m) + (E - 0) = 0 \quad (55)$$

$$E = c^2\,(m_{Tot} - m) - c^2\,(m_0 - m) \quad (56)$$

$$E = (m_{Tot} - m_0)\,c^2 = m_{extra}\,c^2 \quad (57)$$

Checking in this way that the plane is effectively tangent to the curved surface.

There is some relation between equations (34) and (45). In order to see it, the variable m_{Tot} will be extracted from equation (45), obtaining,

$${m_{Tot}}^2 - \frac{2\,E}{c^2} m_{Tot} - {m_0}^2 = 0 \quad (58)$$

$$m_{Tot} = \frac{\frac{2\,E}{c^2} \pm \sqrt{\frac{4\,E^2}{c^4} + 4{m_0}^2}}{2} \quad (59)$$

Considering only the positive value of the mass,

$$m_{Tot} = \frac{E}{c^2} + \sqrt{\frac{E^2}{c^4} + {m_0}^2} \quad (60)$$

Assuming that $\frac{E^2}{c^4}$ is negligible in comparison to ${m_0}^2$, then,

$$m_{Tot} = \frac{E}{c^2} + m_0 \quad (61)$$

Which in the end leads to,

$$E = (m_{Tot} - m_0)\,c^2 \quad (62)$$

In such a way that the equation (34) could be understood as an approximation of (45), if $\frac{E^2}{c^4}$ is much smaller than ${m_0}^2$.

On the other hand, it should be remembered that $E = m\,c^2$ is actually a specific case in which the particle considered has no velocity according to the reference.
In it had velocity, the expression becomes,

$$E^2 = (m\,c^2)^2 + (pc)^2 \quad (63)$$

Being p the linear momentum of the study particle. However, this generalization is not necessary with the proposed equation (37), since it already considers all the specific energy according to the desired reference.

With one of the corollaries of this section, the author states, in his belief, that energy is not matter. Energy affects the weight of matter, which is not the same.
Finally, an idea of importance is reexplained:

TABLE I. Differences between Theories

Relativity Theory	**This Theory**
$m = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}}$	$m = \frac{m_0}{\sqrt{1 - \frac{\varepsilon}{c^2/2}}}$
$E = (m_{Total} - m_0)\,c^2$	$E = \frac{c^2}{2}\left(m_{Tot} - \frac{{m_0}^2}{m_{Tot}}\right)$

That ultimately summarizes that both formulas in the right column are the same equation but ordered in two different ways, while the two on the left are different formulas.

Finally, a brief comment concerning dark matter is made. Dark matter has been conceived by the human being to solve the differences between predictions and observations related to certain gravitational effects. In fact, in order to use current theories of gravitation, it would be necessary to have more mass than what it is observed. But this problem perhaps could be solved with the new understanding of mass proposed. Where, the mass is greater, the greater its energy. This might be an answer that can reconcile observation and theory. However, it would imply that dark matter does not exist.

Going back to Table I, Fig. 4 and Fig. 5, it can be seen that there is a very important difference between both solutions. That although in the small world of experiments on Earth both theories predict similar results, in the vastness of outer space they lead to completely different predictions. All this, together with the fact that dark matter has not been observed so far, leads the author to think that this might be a product of the human being.

Additionally, and following with the equations suggested in this article, Ref. [7] also talks about a possible explanation of the origin of the universe (using the energy limit) and the interpretation of dark energy.

---

[1] A. Einstein, *On the electrodynamics of moving bodies*. Annalen der. Physik **17** (1905).

[2] A.Einstein, *The field equations of Gravitation*. Sitzungsberichte der Königlich Preußischen Akademie der Wissenschaften (Berlin), Seite 844-847 (1915).

[3] A.Einstein, *Relativity: the Special and General Theory* (1916).

[4] J. D. Bekenstein, *Black holes and entropy* Phys. Rev. D **7**, (1973).

[5] Hawking, S. W. & Ellis, G. F. R, *The Large Scale Structure of Space-time* (Cambridge University Press, 1973).

[6] K. Schwarzschild, *Über das Gravitationsfeld eines Massenpunktes nach der Einsteinschen Theorie*. Sitzungsberichte der Königlich Preußischen Akademie der Wissenschaften (Berlin), Seite 189-196. (1916).

[7] J. Viaña, *Theoria Temporis* (2019).

[8] A. Einstein, *Does the Inertia of a Body Depend Upon Its Energy Content?* Annalen der. Physik **18** (1905).