Proposal of an Alternative Perspective of the Time Theory

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A formula has been developed that defines the relativity of time in a novel approach. In the present paper, this is particularized for cases of temporary dilation due to speed and gravity. Using the previous equation, that serves as basis of the theory proposed, an interpretation of the nature of Black Holes, their formation, growth, and dimension can be developed. Which ultimately leads to an alternative understanding of mass and energy.

Keywords: time, energy, relativity, Black Holes

I. INTRODUCTION

Relativity has contributed with a perspective of space and time synergy 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 comprehension of the laws that govern the universe in which we all live.

II. THE TIME EQUATION

The variable α, depends on both the velocity (v) and the speed of light (c),

$$\alpha = \sqrt{1-\frac{v^2}{c^2}} \tag{1}$$

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

$$\frac{d}{dT}(\alpha) = \frac{d}{dT}\left(\sqrt{1-\frac{v^2}{c^2}}\right) \tag{2}$$

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

$$\frac{dv}{dT} = a \tag{3}$$

Being a the acceleration of the particle. Solving in (2),

$$\frac{d}{dT}(\alpha) = \frac{1}{2}\frac{-\frac{2va}{c^2}}{\sqrt{1-\frac{v^2}{c^2}}} \tag{4}$$

$$\int \sqrt{1-\frac{v^2}{c^2}}\ d(\alpha) = \int -\frac{va}{c^2}\ dT \tag{5}$$

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

$$\int \alpha\ d(\alpha) = \int -\frac{mva}{mc^2}\ dT \tag{6}$$

Applying the knowledge of Newtonian physics,

$$F = m\,a \tag{7}$$

$$P = F\,v \tag{8}$$

Where F is the force applied to the particle and P its power. Note that some variables like the F or the a do not necessarily need to exist, but for the demonstration, as a general case, they are considered,

$$\int \alpha\ d(\alpha) = \int -\frac{P}{mc^2}\ dT \tag{9}$$

On the other hand, energy E is defined as,

$$E = \int P\ dT \tag{10}$$

Putting everything together and integrating on both sides,

$$\frac{1}{2}(\alpha)^2 = k - \frac{E}{mc^2} \tag{11}$$

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

$$\varepsilon = \frac{E}{m} \tag{12}$$

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

$$\alpha = \sqrt{1-\frac{\varepsilon}{c^2/2}} \tag{13}$$

Understanding the specific energy ε or $\varepsilon_{A_{r_B}}$ of a particle A as that which arises taking as reference a point B. Being B the origin of zero potential according to the type of energy considered. Which can be calculated dividing the total Newtonian energy of the particle A by its mass, m_A.

$$\varepsilon_{A_{r_B}} = \frac{E^{Newt}{}_{Tot}|_{Ref\ B}}{m_A} \tag{14}$$

The variable α, as defined in (1), is the inverse of the Lorentz Factor (γ), that constitutes one of the pillars of the Relativity Theory [1]. The variable γ relates, for example, T and T', based on the reference frame,

$$T' = T\,\frac{1}{\sqrt{1-\frac{v^2}{c^2}}} \tag{15}$$

In order to get to (13), Newtonian physics were considered. But both the relativistic and the Newtonian approaches should not be mixed together. Unless the criteria of the variable ε is respected. That is, every time ε is substituted, it should be substituted using a Newtonian perspective. This might not seem useful for the moment and perhaps it is not very rigorous. But let it be considered for a moment.

Since the start point was (1), it is known that the energy to which (13) is referring is entirely kinetic. Otherwise, (1) and (13) would not be the same equation. Said that, the equation (15) could be rewritten as,

$$T' = T\,\frac{1}{\sqrt{1-\frac{\varepsilon}{c^2/2}}} \tag{16}$$

Of course, when this factor is particularized to the case of a particle moving at a velocity v,

$$\varepsilon = \varepsilon_{A_{r_B}} = \frac{E_{A_{r_B}}}{m_A} = \frac{\frac{1}{2}\,m_A\left(v_{A_{r_B}}\right)^2}{m_A} = \frac{\frac{1}{2}\,m_A v^2}{m_A} = \frac{v^2}{2} \tag{17}$$

It is obtained the same equation as the one given by (15). But surprisingly, if the particle considered is submitted to the effect of gravity, and thus its energy its entirely gravitational,

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

When substituting in (16), the following formula is obtained,

$$T' = T\,\frac{1}{\sqrt{1-\frac{2GM}{R\,c^2}}} \tag{19}$$

And it is curious that this equation is exactly the one that defines time dilation due to the gravitational effect, according to the general relativity Ref. [2] and [3].

It could be a coincidence, but as every coincidence in physics, it must be studied.

Thus, leaving aside the fact that the Newtonian energy is considered inside a relativistic formula, the author poses the following question which is the pillar of the theory that follows: Could it be possible that the energy, no matter what type it is, distorts the time?

If the equation (16) 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.

III. THE NATURE OF THE BLACK HOLES

But leaving aside the coincidence seen in the prior section, the formula (16) can also be applied to get an interpretation of what the black hole is. 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 T is null, then applying (16), and taking as reference the center of mass of the black hole, it is obtained that,

$$\varepsilon = \frac{c^2}{2} \tag{20}$$

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

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

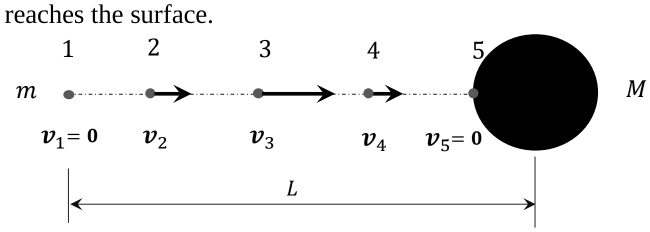

FIG 1. Velocity states of mass m in the approach to a black hole

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 black hole, the particle starts moving, reaching position 2 with a velocity v_2. Its speed increases, until it arrives to point 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 exactly $\frac{c^2}{2}$, the maximum that such particle can have. 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,

$$v_2 < v_3 > v_4 \tag{21}$$

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 jail.

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,

$$\frac{c^2}{2} = \varepsilon \tag{22}$$

$$\frac{c^2}{2} = \frac{1}{m}\, m\, g\, R \tag{23}$$

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

$$R = \frac{2\, G\, M}{c^2} \tag{25}$$

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.

But an interesting point to remark, is the fact that charge does also contribute to the determination of the radius, electrostatic energy in the end. Even more, as shown in Ref. [7], the way it modifies the formula for its radius follows accurately the prediction given by (13).

IV. MASS AND ENERGY

In the same way, (13) may also relate m and m_0,

$$m = \frac{m_0}{\sqrt{1 - \frac{\varepsilon}{c^2/2}}} \tag{26}$$

But this definition of mass poses a great challenge, a complex understanding of what is mass. To visualize the differences between the current conception of mass and the perspective suggested in this theory, a set of masses m_1, m_2 and m_3, will be considered.

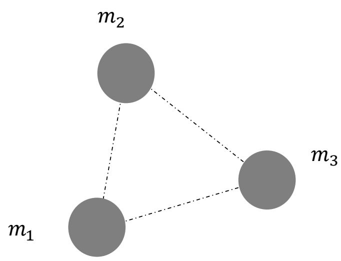

FIG 2. Set formed by three masses, m_1, m_2 and m_3

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

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

$$m_{Tot} = m_1 + m_2 + m_3 + m_{extra} \tag{27}$$

Defining the reference mass without energy as,

$$m_0 = m_1 + m_2 + m_3 \tag{28}$$

Thus being m_{Tot} (the total mass), the addition of both the m_0 and m_{extra},

$$m_{Tot} = m_0 + m_{extra} \tag{29}$$

As it is known from A. Einstein,

$$E = m_{extra}\, c^2 \tag{30}$$

Expressed in a different form,

$$E = (\, m_{Tot} - m_0 \,)\, c^2 \tag{31}$$

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},

$$\varepsilon = \frac{E}{m_{Tot}} = \frac{m_{Tot} - m_0}{m_{Tot}}\, c^2 \tag{32}$$

$$\varepsilon = \left(1 - \frac{m_0}{m_{Tot}}\right) c^2 \tag{33}$$

Let it be renamed the m of equation (26) by m_{Tot}, which despite referring to the same concept, makes it easier to understand.

$$\frac{m_{Tot}}{m_0} = \frac{1}{\sqrt{1 - \frac{\varepsilon}{c^2/2}}} \tag{34}$$

Equations (33) and (34) are the mass – specific energy relationships according to A. Einstein, and according to the author of the present theory, respectively. However, it is observed that they are not equal. This can be visualized by substituting one into another, since such operation should lead to an identity.

$$\frac{m_{Tot}}{m_0} = \frac{1}{\sqrt{2\,\frac{m_0}{m_{Tot}} - 1}} \tag{35}$$

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

$$\frac{1}{y} = \frac{1}{\sqrt{2\,y - 1}} \tag{36}$$

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

$$f_1 = \frac{1}{y} \tag{37}$$

$$f_2 = \frac{1}{\sqrt{2\,y - 1}} \tag{38}$$

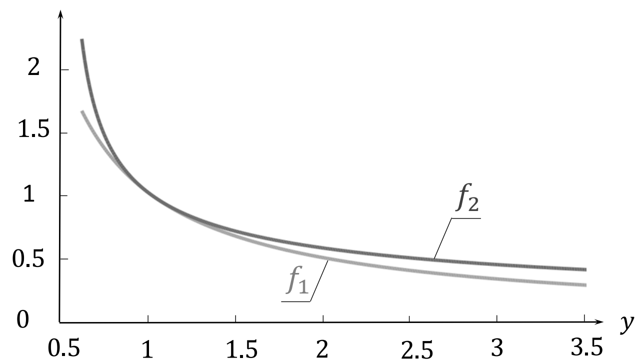

FIG 3. Tangency of functions f_1 y f_2

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. In fact, the experiments we can carry out here on Earth will not have any significant difference in the measurements. Because they would all involve extremely small values of m_{extra}.

But surprisingly, both formulas are very similar, even though their origins are completely different. This is indeed the most interesting point to think about. Each one understands mass in its own way.

Equation (31) says that mass is a linear property, that can be calculated adding up their parts. Simply with a sum.

Indeed, (29) and (30) together they form a system of two equations. Formula (30) without (29) is meaningless.

But equation (34) is suggesting that mass depends on its energy, and that the sum of the parts is not the same as the whole.

It is confusing, because even though that is what we see experimentally and theoretically, we keep using the equation (29) where the masses are added in a linear fashion.

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 and m_{extra}. The author is not against the principle of conservation of mass. But the m_{Total} follows a deeper mathematical understanding, more complex than the sum of the parts that compose it.

If this approach is eventually tested and validated, equation (42) would be the correction of the equation $E = m\,c^2$.

$$\frac{m_{Tot}}{m_0} = \frac{1}{\sqrt{1 - \frac{E}{m_{Tot}\ {c^2}/{2}}}} \tag{39}$$

$$1 - \frac{E}{m_{Tot}\ {c^2}/{2}} = \left(\frac{m_0}{m_{Tot}}\right)^2 \tag{40}$$

$$E = m_{Tot}\ \frac{c^2}{2}\left(1 - \left(\frac{m_0}{m_{Tot}}\right)^2\right) \tag{41}$$

$$E = \frac{c^2}{2}\left(m_{Tot} - \frac{{m_0}^2}{m_{Tot}}\right) \tag{42}$$

This equation (42) is exactly the same as (26), but allows the calculation of the bonding energy, being m_0 and m_{Tot} known.

Let it be studied the difference between (31) and (42). To do this, m_0 y m_{Tot} will be taken as independent variables.

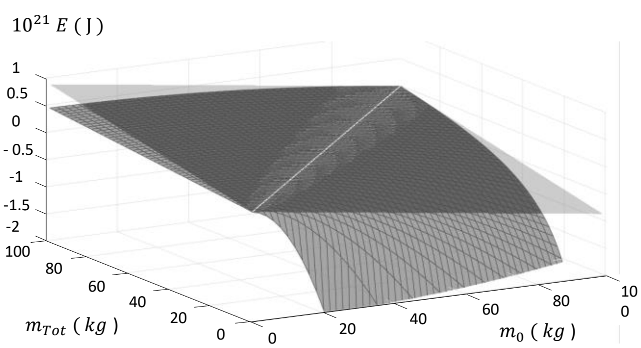

FIG 4**.** Differences between equations (31) and (42)

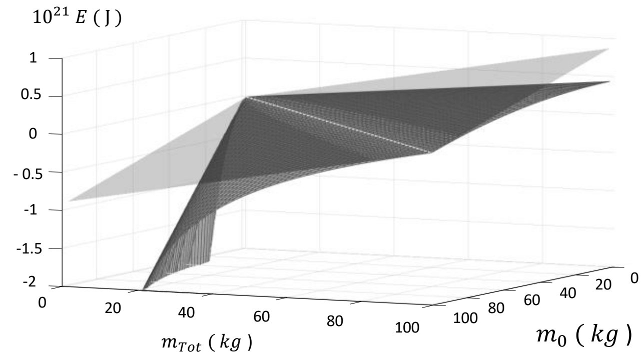

FIG 5**.** Differences between equations (31) and (42)

These representations are of vital importance. The plane represents equation (31) while the curved surface refers to equation (42).

This visualization shows where (31) 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, (31) 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 (31) is tangent to the curved surface (42). 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 development 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 given by,

$$F_x|_P(x - x_P) + F_y|_P(y - y_P) + F_z|_P(z - z_P) = 0 \tag{43}$$

Being F,

$$F = E - \frac{c^2}{2}\left(m_{Tot} - \frac{{m_0}^2}{m_{Tot}}\right) = 0 \tag{44}$$

Renaming with x, y, z,

$$F = z - \frac{c^2}{2}\left(y - \frac{x^2}{y}\right) = 0 \tag{45}$$

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

$$F_x = -\frac{c^2}{2}\left(-\frac{2\,x}{y}\right) \tag{46}$$

$$F_y = -\frac{c^2}{2}\left(1 + \frac{x^2}{y^2}\right) \tag{47}$$

$$F_x = 1 \tag{48}$$

Substituting P it is obtained,

$$F_x|_P = -\frac{c^2}{2}\left(-\frac{2\,m}{m}\right) = c^2 \quad (49)$$

$$F_y\Big|_P = -\frac{c^2}{2}\left(1 + \frac{m^2}{m^2}\right) = -c^2 \quad (50)$$

$$F_z|_P = 1 \quad (51)$$

Finally,

$$c^2\,(m_0 - m) - c^2\,(m_{Tot} - m) + (E - 0) = 0 \quad (52)$$

$$E = c^2\,(m_{Tot} - m) - c^2\,(m_0 - m) \quad (53)$$

$$E = (m_{Tot} - m_0)\,c^2 = m_{extra}\,c^2 \quad (54)$$

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

But still there is some hidden relation between equations (31) and (42) that has not been covered. In order to see it, the variable m_{Tot} will be extracted from equation (42), obtaining,

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

$$m_{Tot} = \frac{\frac{2\,E}{c^2} \pm \sqrt{\frac{4\,E^2}{c^4} + 4m_0{}^2}}{2} \quad (56)$$

Considering only the positive value of the mass,

$$m_{Tot} = \frac{E}{c^2} + \sqrt{\frac{E^2}{c^4} + m_0{}^2} \quad (57)$$

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

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

Which in the end leads to,

$$E = (m_{Tot} - m_0)\,c^2 \quad (59)$$

In such a way that the equation (31) could be understood as an approximation of (42), 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,

$$E^2 = (m\,c^2)^2 + (pc)^2 \quad (60)$$

Being p the linear momentum of the study particle. However, this generalization is not necessary with the proposed equation (26), 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, and of course if the previous holds, that perhaps the energy cannot be converted into matter nor vice versa. But rather the energy affects the weight of matter.

Does this make any sense? Maybe not. But in fact, there are many challenges that we have not been able to solve, that might require new understandings or theories to tackle them. Dark Matter for example can be an interesting concept that helps clarifying the idea of this section. Yet we have not been able to solve the differences between predictions and observations related to certain gravitational effects in the universe. In fact, in order to use current theories of gravitation, it would be necessary to have more mass than what it is observed. Indeed, that is the origin of Dark Matter, it should exist to reconcile both observations and theories. But its nature is so complex that we have never been able to prove its existence. Matter that does not interact, not even electromagnetically, that cannot be seen and still creates a gravitational field. But what if the mass is greater than what we thought it was? What if is heavier the greater its energy is? Would it be still necessary the Dark Matter?

The answers to those questions deserve much more than just the last lines of this short paper. Nevertheless, the author has considered to include these final comments to open the path to future investigations that the readers might consider of interest.

Finally, the major differences between theories is shown in the table below.

TABLE I. Differences between theories

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

Which 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.

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.

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