

ERRORS IN EINSTEIN'S RELATIVITY TRANSFORMATION FORMULA DERIVATION

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GRAPHICAL ABSTRACT: Albert Einstein is a great physicist. He provided the formula that describes the relationship between mass and energy. People consider the formula $E = mc^2$ as the classic of modern physics. It has been considered correct for a long time. The purpose of this article is to demonstrate the irrationality in the process of formula construction. The author gives arguments based on physical and mathematical knowledge to do this. The paper has considered uncertain factors and mentioned fundamental aspects. Although further experimental studies are needed, the author has identified errors in the formula. This result will have a profound impact on the current and future knowledge base as well as other great applications in practice. In addition, although Einstein's name is closely linked with the celebrated relation $E = mc^2$ between mass and energy, a critical examination of the more than half dozen "proofs" of this relation that Einstein produced over a span of forty years shows/tells about that all these proofs suffer from mistakes. Einstein introduced (there was no good reason for) ideas (you think are true), did/done/performed deadly errors in logic, or adopted low–speed, (serving to severely limit or control) close guesses. He never succeeded in producing a valid general proof related to a realistic system with randomly large internal speeds. The first such general proof was produced by Max Laue in 1911 (for "closed" systems with a time–independent energy–speed and power tensor) and it was generalized by Felix Klein in 1918 (for random time–dependent "closed" systems).

[1A] $ds^2 = dt^2 - dx^2 - dy^2 - dz^2$ $ds = dt \sqrt{1 - u^2}$ $(\eta^\sigma) = \left(\frac{m}{\sqrt{1 - u^2}}, \frac{mu_i}{\sqrt{1 - u^2}} \right)$ $(\eta^\sigma) = \left(m + \frac{1}{2} mu^2, mu_i \right)$	[1B] $\frac{mu_i}{\sqrt{1 - u^2}} \text{ Impuls}$ $m \left(\frac{1}{\sqrt{1 - u^2}} - 1 \right) \text{ Kin. Energ.}$	[1E] $\sum \frac{1}{\sqrt{1 - u^2}} = \frac{2}{\sqrt{1 - u'^2} \sqrt{1 - v^2}}$ $\sum \frac{u_i}{\sqrt{1 - u^2}} = \frac{2v}{\sqrt{1 - u'^2} \sqrt{1 - v^2}}$
[1C] Sp. Lor. Transf. $t = \frac{t' + v x'}{\sqrt{1 - v^2}}$	[1D] $x = \frac{x' + v t'}{\sqrt{1 - v^2}}, y = y', z = z'$	[1F] Hyp. $\sum I_v = \sum \bar{I}_v$ Cons. $\sum E = \sum \bar{E} \quad L.$ [1G] $I_v = mu_v F(u)$ $E = E_0 + m G(u)$

BLACKBOARD #1

[2B] K' [2E] $\Delta E_0 = \Delta m$ $E_0 = m$	[2A] $E = E_0 + m\left(\frac{1}{\sqrt{1-u^2}} - 1\right)$ [2C] En. K $2E_0 + m\left(\frac{1}{\sqrt{1-u_+^2}} - 1\right) + m\left(\frac{1}{\sqrt{1-u_-^2}} - 1\right) = 2\bar{E}_0 + \bar{m}\left(\frac{1}{\sqrt{1-\bar{u}_+^2}} - 1\right) + \bar{m}\left(\frac{1}{\sqrt{1-\bar{u}_-^2}} - 1\right)$ En. K' $2E_0 + 2m\left(\frac{1}{\sqrt{1-u'^2}} - 1\right) = 2\bar{E}_0 + 2\bar{m}\left(\frac{1}{\sqrt{1-\bar{u}'^2}} - 1\right)$ $E_0 - m + \left(\frac{m}{\sqrt{1-u'^2}\sqrt{1-v^2}}\right) = \bar{E}_0 - \bar{m} + \left(\frac{\bar{m}}{\sqrt{1-\bar{u}'^2}\sqrt{1-v^2}}\right)$ $E_0 - m + \left(\frac{m}{\sqrt{1-u'^2}}\right) = \bar{E}_0 - \bar{m} + \left(\frac{\bar{m}}{\sqrt{1-\bar{u}'^2}}\right)$ [2D] $[(\bar{E}_0 - E_0) - (\bar{m} - m)]\left(\frac{1}{\sqrt{1-v^2}} - 1\right) = 0$
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BLACKBOARD#2

Mistakes and Errors in the Einstein's Equation $E=mc^2$

Using Lorentz Transformations, Galilean

Transformations, Prandtl–Glauert Transformation and Quaternion Lorentz Transformations.

Keywords: Modern Physics, Quantum Mechanics, Relativism, The Einstein Theory of Relativity, Theoretical Physics, General Relativity, Special Relativity, 4-Dimensional Spacetime, Lorentz Transformations, Galilean Transformations, Prandtl–Glauert Transformation, Quaternion Lorentz Transformations.

1.

INTRODUCTION

Albert Einstein's formula is one of the most famous equations in the history of physics, expressing the equivalence relationship between energy (E) and mass (m), where c is the speed of light in a vacuum. Although this formula is very famous, proving it is not simple and requires a deep understanding of **Einstein's Theory of Special Relativity**.

The Meaning of $E = mc^2$:

The formula $E = mc^2$ is not only a mathematical equation but also a revolutionary discovery:

- The equivalence between mass and energy: It proves that mass and energy are not two separate entities, but they can convert into each other. Mass can be considered a form of "frozen" energy, and conversely, energy can "create" mass [1–299].
- Explanation of nuclear phenomena: This is the basis for explaining the enormous energy released in nuclear reactions (nuclear fission and fusion), such as in atomic bombs or solar energy. A small amount of mass "lost" in the reaction will be converted into energy [300–590].

- The foundation of modern physics: This formula is one of the pillars of modern physics and has completely changed the way we understand the universe, from the structure of matter to the evolution of stars [591–677].

- The **Lorentz factor**, $\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$, is a dimensionless

quantity that naturally emerges in the equations of Special Relativity. It describes how measurements of time, length, and other physical properties change when an object moves at a high relative velocity.

The derivation of the Lorentz factor stems directly from Einstein's two postulates of Special Relativity:

1. **Principle of Relativity:** The laws of physics are the same in all inertial frames of reference.
2. **Invariance of the Speed of Light:** The speed of light in a vacuum (c) is the same for all observers, regardless of the relative motion of the light source or the observer.

Below is a common approach to derive the Lorentz factor, often done by considering **time dilation**:

Deriving the Lorentz Factor from Time Dilation

Imagine a simple "light clock" consisting of two parallel mirrors separated by a distance L_0 . A photon of light bounces back and forth between these two mirrors. Each time the photon hits a mirror, it's considered a "tick" of the clock.

Case 1: The clock is at rest in reference frame S_0 (proper frame)

In the reference frame S_0 where the clock is at rest, the photon travels a distance L_0 to go from one mirror to the other.

The time for the photon to travel one way is $\Delta t_0 = \frac{L_0}{c}$.

So, the time for one "tick" (photon going forth and back) is

$$2\Delta t_0 = \frac{2L_0}{c}.$$

Case 2: The clock is moving in reference frame S

Now, let's consider this clock moving at a velocity v parallel to the mirror surfaces (i.e., perpendicular to the photon's path) relative to an observer in reference frame S.

- From the perspective of the observer in frame S:
- The photon must still travel diagonally to get from one mirror to the other, because the mirrors are moving sideways.
- The total distance the photon travels during one "tick" (going from one mirror to the other and back) will be longer than $2L_0$.

Let's look at half a "tick" (the photon going from the bottom mirror to the top mirror). During this time, the photon travels a distance $c\Delta t$, and the clock itself moves a distance $v\Delta t$.

We can visualize a right-angled triangle with:

- The hypotenuse being the distance the photon travels: $c\Delta t$
- One leg being the vertical distance between the mirrors: L_0
- The other leg being the distance the clock moves

horizontally: $v\Delta t$. $v\Delta t$ (more precisely, $v\frac{\Delta t}{2}$ to reach the

midpoint of the horizontal path, and then another $v\frac{\Delta t}{2}$ to reach the end point).

Applying the Pythagorean theorem for one half of the light's journey (let Δt be the time for the light to travel from one mirror to the other in frame S):

$$(c\Delta t)^2 = L_0^2 + (v\Delta t)^2 \quad (1)$$

Rearrange the equation:

$$c^2 (\Delta t)^2 = L_0^2 + v^2 (\Delta t)^2 \quad (2)$$

$$c^2 (\Delta t)^2 - v^2 (\Delta t)^2 = L_0^2 \quad (3)$$

$$(\Delta t)^2 (c^2 - v^2) = L_0^2 \quad (4)$$

$$(\Delta t)^2 = \frac{L_0^2}{c^2 - v^2} \quad (5)$$

$$(\Delta t)^2 = \frac{L_0^2}{c^2 \left(1 - \frac{v^2}{c^2}\right)} \quad (6)$$

$$\Delta t = \frac{L_0}{c \sqrt{1 - \frac{v^2}{c^2}}} \quad (7)$$

We know that $\Delta t_0 = \frac{L_0}{c}$ is the proper time (when the clock is

at rest). Substituting this into the equation above:

$$\Delta t = \frac{\Delta t_0}{\sqrt{1 - \frac{v^2}{c^2}}} \quad (8)$$

and this is exactly where the Lorentz factor appears.

$$\Delta t = \gamma \Delta t_0 \quad (9)$$

where:

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} \quad (10)$$

Significance of the Lorentz Factor:

When $v=0$: $\gamma = \frac{1}{1-0} = 1$. This means that when there is no

relative motion, time passes the same for both observers, and there are no relativistic effects.

When $v \rightarrow c$ (velocity approaches the speed of light): The

denominator $\sqrt{1 - \frac{v^2}{c^2}}$ approaches 0, and γ approaches

infinity $(\infty) \cdot (\infty)$. This leads to infinite time dilation

$(\Delta t \rightarrow \infty)$ and infinite length contraction ($L' \rightarrow 0$),

indicating that objects with mass cannot reach the speed of light.

Value is always greater than or equal to 1: $\gamma \geq 1$.

The Lorentz factor is a crucial element in all Lorentz transformations and other relativistic formulas, including $E = mc^2$ (where the total energy of a moving object is $E = \gamma mc^2$). It directly illustrates the fundamental difference between classical (Newtonian) physics and relativistic (Einsteinian) physics when dealing with high velocities.

2. METHOD

In the above thought experiment, the Lorentz coefficient was wrong at one point. In the general case, two mirrors are parallel to each other, and light photons move, but the Pythagorean theorem cannot always apply to the calculation. Let us consider a few specific images below (Figures 1–4):

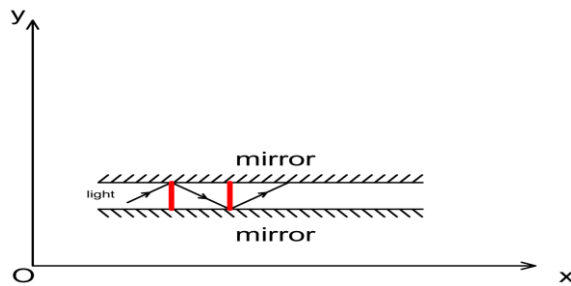


FIGURE (1): LIGHT MOVES IN MIRROR (NON-CURVED).

When a light is moving in mirror (non-curved), we can use this diagram to calculate the following: the red lines represent the lines involved in the calculation using the Pythagorean theorem.

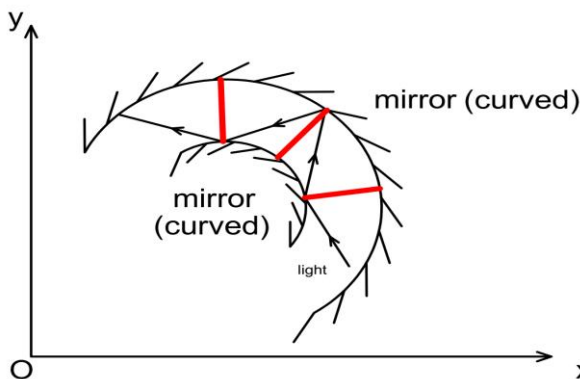


Figure (1): Light moves in mirror (curved).

When light moves along a curved trajectory, the red lines do not form a right triangle, so we cannot use the Pythagorean theorem to calculate. Thus, in this case, the Lorentz coefficient cannot be calculated. From this, we inferred that the formula $E = \gamma mc^2$ is wrong in general. So, all the consequences arising from this formula are also wrong.

Let us recall the Lorentz transformation:

The Lorentz transformation is a transformation of spatial and temporal coordinates so that they satisfy Einstein's two postulates. Lorentz proposed the following coordinate system:

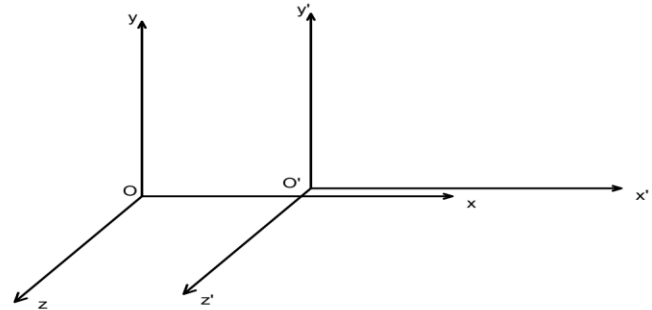


FIGURE (2): COORDINATE SYSTEM PROPOSED BY LORENTZ.

Lorentz argues that O and O' are two inertial reference frames. O' moves in a straight line with O at a velocity v so that $O'x'$ slides along Ox . Then, the spatial coordinates: $y' = y$, $z' = z$. Based on this argument, Lorentz constructed the gamma coefficient, which we have known above.

There is a fundamental mistake in the above argument, which is: O and O' are two inertial reference frames. However, O' does not necessarily have to slide along Ox to preserve the properties of the inertial reference frame. In the most general case, O' (x', y', z') with $x' \neq x$; $y' \neq y$; $z' \neq z$. In this general case, O' still satisfies Einstein's two postulates (that is, O' is an inertial reference frame). We described this coordinate system in the following figure:

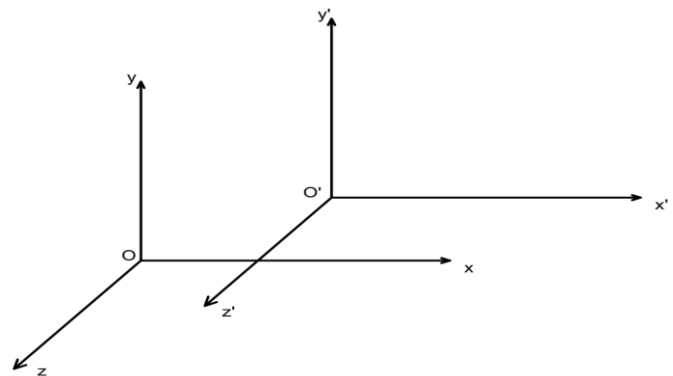


FIGURE (3): COORDINATE SYSTEM PROPOSED BY THE ARTICLE.

In our 3-dimensional physical space, the coordinate system satisfies a very general property. Lorentz's argument is a special case. Therefore, Lorentz's calculation is wrong.

Albert Einstein's principle applies to inertial reference frames, that is, only to objects moving in a straight line and uniformly or standing still. However, in the universe, due to the influence of gravitational, electromagnetic and environmental forces, there are no such objects. The article proposes an example as follows:

Time passes faster for satellites in Earth orbit due to the effect of relativity. Specifically, according to the special theory of relativity, fast motion causes time to pass more slowly, whereas according to the general theory of relativity, weaker gravity at high altitudes causes time to pass more quickly.

For GPS satellites, the atomic clocks on them record that time passes about 45.7 microseconds faster per day than clocks on the ground.

This classic figure has been written and calculated in physics textbooks. Whether on Earth or in space. The satellite's orbit is a curve. The situation is an accelerated motion, so it is not an inertial reference frame. Additionally, the Earth's orbit is curved. However, the data from atomic clocks still record the above results.

In essence, light travels straight, but due to the influence of gravity, it follows a curved path when passing through space. Thus, we cannot calculate the Lorentz coefficient.

In addition to the above issues, the refractive index of the medium is also an important factor. We know that: $n = \frac{c}{v}$ in which: n – is the refractive index of the medium, v – the speed of light in that medium, c – is the speed of light in a vacuum.

Although our air is skinny, the refractive index $n > 1$ is certain, so $v < c$. In that particular environment, Albert Einstein did not consider this factor. Moreover, this is another mistake in the formula $E = mc^2$. In air, the refractive index n varies according to the density of the air. We also see that the humidity of the air is also an important influence. Therefore, the path of the light ray is also very complicated. The Lorentz coefficient is also very difficult to determine.

3. Results

In this study, we analyzed the model and mathematical methods, obtaining some important results. Specifically, we proved that the central equation $E = mc^2$ is wrong through mathematical and physical arguments. These arguments show that the relationship between mass and energy is not correct in the general case. Additionally, we observed that constructing a correct formula to represent the relationship between mass and energy is a highly complex task. The correct formula will include many variables and constraints on different specific physical conditions. Therefore, this correct formula will provide more insight into its application and potential in the future.

4. DISCUSSION

The article highlights the mistakes made by Albert Einstein when formulating $E = mc^2$. Although, in general, this is an incorrect formula, some of its basic meanings are still valid. Because, in the specific case of translational motion, the formula remains correct, it is still valuable in explaining nuclear phenomena, including the relationship between mass and energy. In addition to these values, the results of the process of proving the formula will profoundly affect the foundations of modern physics. This article still needs further research to determine the correct formula for the relationship between energy and mass.

5. CONCLUSIONS

This article has contributed to our understanding of the field of physics, refuted the correctness of one of the classic physics formulas, and brought practical value to society. Finally, the author hopes that the proven correctness will continue to serve as a premise for future potential research.

6. Conflict of Interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

7. Acknowledgements

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