Einstein Revised

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May, 07, 2019

"The secret to creativity is knowing how to hide your sources."
A.Einstein

Planned to write this article long time ago. It is the original Einstein's paper along with my comments in blue. Want to take a look at the genius of Einstein? Just keep reading.

DOES THE INERTIA OF A BODY DEPEND UPON ITS ENERGY-CONTENT?

By A. EINSTEIN

September 27, 1905

The results of the previous investigation lead to a very interesting conclusion, which is here to be deduced.

I based that investigation on the Maxwell-Hertz equations for empty space, together with the Maxwellian expression for the electromagnetic energy of space, and in addition the principle that:—

The laws by which the states of physical systems alter are independent of the alternative, to which of two systems of coordinates, in uniform motion of parallel translation relatively to each other, these alterations of state are referred (principle of relativity).

With these principles* as my basis I deduced *inter alia* the following result (§ 8):—

Let a system of plane waves of light, referred to the system of co-ordinates (x, y, z), possess the energy l; let the direction of the ray (the wave-normal) make an angle - with the axis of x of the system. If we introduce a new system of co-ordinates (ξ, η, ζ) moving in uniform parallel translation with respect to the system (x, y, z), and having its origin

of co-ordinates in motion along the axis of x with the velocity v, then this quantity of light—measured in the system (ξ, η, ζ)—possesses the energy

$$l^* = l\frac{1-\frac{v}{c}cos(\varphi)}{\sqrt{1-v^2/c^2}}$$

where c denotes the velocity of light. We shall make use of this result in what follows.

* The principle of the constancy of the velocity of light is of course contained in Maxwell's equations.

Anybody reading this will ask themselves from where this formula derives. There are no sources given. This formula first appeared in Einstein's previous paper, 'On the Electrodynamics of Moving Bodies'. For the purposes of this article, let's for now assume the formula holds true.

Let there be a stationary body in the system (x, y, z), and let its energy—referred to the system (x, y, z) be E_0. Let the energy of the body relative to the system (ξ, η, ζ) moving as above with the velocity v, be H_0.

Let this body send out, in a direction making an angle φ with the axis of x, plane waves of light, of energy $\frac{1}{2}L$ measured relatively to (x, y, z), and simultaneously an equal quantity of light in the opposite direction.

Please remember this second light wave. It's a nice trick, and I will explain how it works later.

Meanwhile the body remains at rest with respect to the system (x, y, z). The principle of energy must apply to this process, and in fact (by the principle of relativity) with respect to both systems of co-ordinates. If we call the energy of the body after the emission of light E_1 or H_1 respectively, measured relatively to the system (x, y, z) or (ξ, η, ζ) respectively, then by employing the relation given above we obtain

$$E_0 = E_1 + \frac{1}{2}L + \frac{1}{2}L$$

$$H_0 = H_1 + \frac{1}{2}L\frac{1-\frac{v}{c}cos(\varphi)}{\sqrt{1-v^2/c^2}} + \frac{1}{2}L\frac{1+\frac{v}{c}cos(\varphi)}{\sqrt{1-v^2/c^2}}$$

$$= H_1 + \frac{L}{\sqrt{1-v^2/c^2}}$$

By subtraction we obtain from these equations

$$H_0 - E_0 - (H_1 - E_1) = L\left\{\frac{1}{\sqrt{1-v^2/c^2}} - 1\right\}$$

This is a classic Einstein trick. He attempts to conceal the sources or 'know-how' behind the formula. He does this by employing mathematical constructions which are based far outside reality. Formulae used in physics are different from those used in mathematics. They must have a real meaning in the physical world. Here's an example. Two people each boiling an egg, one in New York, the other in Chicago. The times are the same:

$$T_{END}^{NY} - T_{START}^{NY} = T_{END}^{CH} - T_{END}^{CH}$$

By rearranging the variables we can write this as:

$$T_{END}^{NY} - T_{END}^{CH} = T_{START}^{NY} - T_{START}^{CH}$$

Is this a valid physics formula? Of course not! Neither left nor right sides of the equation contain a physical meaning. We cannot even factor in the time shift between the two cities, as we cannot be sure if either clock used to time the eggs boiling are running fast or slow.

What physical meaning can be derived by subtracting the total energy of a system at rest from the total energy of one that is moving? The only valid answer is none.

The two differences of the form $H - E$ occurring in this expression have simple physical significations.

Where's the explanation of such simplicity?

H and E are energy values of the same body referred to two systems of co-ordinates which are in motion relatively to each other, the body being at rest in one of the two systems (system (x, y, z)). Thus it is clear that the difference $H-E$ can differ from the kinetic energy K of the body, with respect to the other system (ξ, η, ζ), only by an additive constant C, which depends on the choice of the arbitrary additive constants of the energies H and E. Thus we may place

$$H_0 - E_0 = K_0 + C$$
$$H_1 - E_1 = K_1 + C$$

since C does not change during the emission of light.

Another nice trick. The formulas do not follow from previous equations. They are unrelated conjectures.

Something else left unexplained is the discrepancy between the left and right sides of the equation. The left side applies to different reference frames, but what about the right? Does the kinetic energy parameter pertain to a system at rest or one that is moving? Questions, questions…

In the past these frame manipulations might have convinced us that radiated light energy was derived from kinetic energy. But this is a fallacy, and here's why. We have two reference frames. In the first the body is stationary, while in the second it is moving at constant speed. Einstein's 'genius' tries to prove that in the second frame radiated light energy is created from the kinetic energy present in the moving system. If so, from where is the energy created in the first frame when the body is at rest and kinetic energy equals zero? The only possible answer is that it's created from another form of energy, such as potential or chemical energy. And yet the physical processes should be similar in every inertial reference frame. How can it be that light radiation derives from kinetic energy in one frame, chemical in a second, and maybe electrical in a third? Can the chemical energy of a body or even its physical temperature be altered simply by moving around it?

Imagine two boys in a moving boat, each with a slingshot. Each boy shoots in opposite directions to the other. From where does the 'radiated energy' come? The mathematical equations listed above give us the answer that it comes from the kinetic energy present in the moving boat. And yet common sense and empirical measurement would tell us otherwise. The radiated energy must come from the potential energy contained in the rubber slingshot.

But let's pretend the change is due to the kinetic energy of the moving boat, and see what happens next.

So we have

$$K_0 - K_1 = L\left\{\frac{1}{\sqrt{1 - v^2/c^2}} - 1\right\}$$

The kinetic energy of the body with respect to (ξ, η, ζ) diminishes as a result of the emission of light, and the amount of diminution is independent of the properties of the body. Moreover, the difference $K_0 - K_1$, like the kinetic energy of the electron (§ 10), depends on the velocity.

Neglecting magnitudes of fourth and higher orders we may place

$$K_0 - K_1 = \frac{1}{2}\frac{L}{c^2}v^2$$

This is definitely not the right way to do approximations. We are not given the conditions, so we must provide them ourselves. The only possible condition, which allow us to simplify formulae, will be:

$$v \ll c$$

What a surprise! The magic formula $E=mc^2$ cannot even be derived for relativistic speed! It is valid only for velocities much less than the speed of light.

But there's more.

From this equation it directly follows that:—

If a body gives off the energy L in the form of radiation, its mass diminishes by L/c2.

We accept that the kinetic energy of the body has decreased, but why the mass decreased? If kinetic energy is dependent on velocity, why has the latter not decreased?

Now recall Einstein's theoretical experiment where two beams of light are shone in opposite directions. Here, momentum and velocity are both constant. If we consider light emitted by a single beam, or two beams non-opposing in direction, we can now see how $E=mc^2$ cannot possibly be derived. The same holds true when light is not emitted. Consider also that hydrogen, which remains in its ground state up to a temperature of 3,000K, cannot emit light. Thus does it then follow that $E=mc^2$ is not valid for hydrogen at room temperature?

Current physics theory accepts the following mechanism of light emission. The electron jumps to a lower energy level and emits ONE photon. The direction of this emission is not specified.

The fact that the energy withdrawn from the body becomes energy of radiation evidently makes no difference, so that we are led to the more general conclusion that

The mass of a body is a measure of its energy-content; if the energy changes by L, the mass changes in the same sense by $L/9 \times 10^{20}$, the energy being measured in ergs, and the mass in grammes.

It is not impossible that with bodies whose energy-content is variable to a high degree (e.g. with radium salts) the theory may be successfully put to the test.

If the theory corresponds to the facts, radiation conveys inertia between the emitting and absorbing bodies.

About this Document

This edition of Einstein's Does the Inertia of a Body Depend upon its Energy-Content is based on the English translation of his original 1905 German-language paper (published as Ist die Trägheit eines Körpers von seinem Energiegehalt abhängig?, in Annalen der Physik. 18:639, 1905) which appeared in the book The Principle of Relativity, published in 1923 by Methuen and Company, Ltd. of London. Most of the papers in that collection are English translations by W. Perrett and G.B. Jeffery from the German Das Relativatsprinzip, 4th ed., published by in 1922 by Tuebner. All of these sources are now in the public domain; this document, derived from them, remains in the public domain and may be reproduced in any manner or medium without permission, restriction, attribution, or compensation.

The footnote is as it appeared in the 1923 edition. The 1923 English translation modified the notation used in Einstein's 1905 paper to conform to that in use by the 1920's; for example, c denotes the speed of light, as opposed the V used by Einstein in 1905. In this paper Einstein uses L to denote energy; the italicised sentence in the conclusion may be written as the equation "m = L/c2" which, using the more modern E instead of L to denote energy, may be trivially rewritten as "E = mc2".

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Conclusion

The validity of famous formula $E=mc^2$ is seriously doubted. This formula is the only ground for positive energy output from the reaction of nuclear fusion. Why do you think the fusion is always few years away?