

Peer Review

Review of: "E=mc² Is Not a Relativistic Formula"

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Report on the paper "E=mc² is not a relativistic formula" by Qing-Ping Ma

Although he did not publish it, Paul Langevin, like Planck and de Pretto, was also one of the precursors who foresaw this mythical formula of physics $E=m_0c^2$. I'm not going to discuss the substance, because it is now well established that the exact formula is $E=m_0c^2$, m_0 being the rest mass. I will discuss the form, which reveals in my opinion, the author's lack of understanding of the history of science. Claiming that the formula $E=m_0c^2$ can be a classical formula is to have failed to understand a very essence of Einstein's contribution to physics and, more specifically, special relativity. Indeed, pre-Einstein physics was in crisis. Classical Newtonian physics offered equations for which changes of Galilean reference frame were made by a simple Galilean transformation, in other words, by a simple composition of velocities [1,2]. Maxwell's equations, however, do not obey such a transformation. It was Lorentz and Poincaré who found these transformations, and it was Einstein who applied them to mechanics to construct special relativity. Special relativity was a collective work, but Einstein's contribution was crucial because he gave an elegant physical explanation for the Galilean transformation as an approximation of Lorentz's transformations: these were Minkowski space quadrivector rotations. Above all, he reconciled classical Newtonian mechanics with electromagnetism and Maxwell's equations.

So today, saying that $E=m_0c^2$ can be obtained using classical equations by mixing Newton and Maxwell makes no sense, because special relativity is precisely the theory that unified mechanics and electromagnetism. There is no such thing as a purely classical or purely relativistic demonstration, because the former is only an approximation of the latter, and mixing $P=E/c$ of electromagnetism with $P=mv$ of mechanics is like going through the history of science in the opposite direction, back to the time when these two disciplines were incompatible, and forcing them to mix to produce a hybrid of

special relativity. It is special relativity that explains how and why electromagnetism and mechanics can be merged. So $E=m_0c^2$ is necessarily relativistic.

There is, however, space to express Einstein's technical mistakes in his demonstration. But the title should be changed, and the paper deeply modified to account for the previous crucial point.

[1] The meaning of relativity, Ed, Barnes and Nobles Book, New York, 5th edition, p. 32 (1984)

[2] A mechanistic interpretation of relativistic rigid body rotation. Sci Rep 13, 9047 (2023).

Declarations

Potential competing interests: No potential competing interests to declare.