Experimental evidence of E ≠ mc^2

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Abstract – Presented measured energies of charged particles in space, so called cosmic rays, prove themselves that the expression E= mc^2 is untenable.

Introduction

The definition of cosmic rays as found on Wikipedia sounds: "Cosmic rays are high-energy protons and atomic nuclei which move through space at nearly the speed of light."
In this article a closer investigation is shown concentrated on just protons.

The concept "nearly the speed of light"

The importance of this concept is found in the expression E = mc^2, in which the mass m is considered to be dependant on its velocity v in accordance with the alleged function

$$m = m_{rest} /\sqrt{(1-v^2/c^2)}, \text{ shortly expressed as } m = \gamma\, m_{rest}$$

Because only velocities of nearly the speed of light will be considered, v will be presented as

$$v = c - \varepsilon_v \text{ , with } \varepsilon_v \text{ negligible w.r.t. } c.$$

Given: $1-v^2/c^2 = c^{-2}(c^2-v^2) = c^{-2}(c-v)*(c+v) \approx c^{-2}\, \varepsilon_v\, 2c = 2\varepsilon_v/c$, the expression for m can be approximated sufficient accurately, regarding the purpose of this article, by

$$m \approx \sqrt{c/2\varepsilon_v}\, m_{rest}.$$

The alleged energy of such a mass is E= $\sqrt{(c/2\varepsilon_v)}\, m_{rest}\, c^2$ Joule = $6.25\times10^{18}\sqrt{(c/2\varepsilon_v)}\, m_{rest}\, c^2$ eV.

Table I shows a few examples for $m_{rest} = 1.7\times10^{-27}$ kg, the mass of a proton. These examples are based on the text written in reference [1]:

"*Cosmic rays attract great interest practically, ... and scientifically, because the energies of the most energetic ultra-high-energy cosmic rays have been observed to approach 3×10^{20} eV, about 40 million times the energy of particles accelerated by the Large Hadron Collider ($7.5*10^{12}$ eV).*
One can show that such enormous energies might be achieved by means of the centrifugal mechanism of acceleration in active galactic nuclei. At 50 J, the highest-energy ultra-high-energy cosmic rays (such as the Oh-My-God particle recorded in 1991)....... "

ε_v (m/s)	γ	Joule	eV	specification
c	1	1,5E-10	9,6E+08	
30000	71	3,0E-09	1,9E+10	
135	1000	1,6E-07	1E+12	CERN
2,4	7872	1,2E-06	**7,5E+12**	LHC
1,4E-15	3,3E+11	**50**	**3E+20**	Oh-My-God

Table I Examples of measured energies

Remark:
The velocity of light, relative to its source, can be calculated on the basis of the generally accepted physical laws for Electro-Magnetic fields. See reference [3]. Given this *Electro-Magnetic* property, why would a *mass* obey the restriction that its velocity, relative its source too, cannot be higher than ***c***?
And even more unrealistic: how is it physically possible that it gets a velocity approaching ***c*** with an arbitrary small difference, but not zero? Like the "Oh-My-God" particle is assumed to have done.

Three fundamental problems of E = mc^2

1 The ambiguous definition of v

Up to now the reference for the velocity v of the particle has not been defined. The most obvious one is its (last) source, where it got this velocity, and that has been maintained until it reached earth.
If the earth, where these energies are measured, would be taken as reference, all the outcomes would vary extremely strongly with the position of the earth on its orbit around the sun, for the simple reason that its orbital velocity v_e is 3×10^4 m/s.
Suppose we consider protons approaching earth in the plane of its orbit with velocity v_{pz} *relative to the sun*. In such a configuration the velocity of the proton *relative to earth* would be: $v_{pz}+v_e\sin(2\pi\ \text{rad/year}\times t)$.
Taking v_{pz} , for the ease of the discussion, equal to $\boldsymbol{c} - \varepsilon_v$, the velocity to be applied in the calculation of γ would vary extremely strong. And so would the measured energy. If this would be the case, it would have been published immediately, claiming that the most convincing evidence of the validity of E = m$\boldsymbol{c}^2$ and thus of the theory of relativity had been found.

The text in Wikipedia continues with: "*Most cosmic rays, however, do not have such extreme energies; the energy distribution of cosmic rays peaks on 0.3 GeV (4.8×10^{-11} Joule).*"
Table 1 shows the lowest possible value of $\gamma\ m_{rest}\ \boldsymbol{c}^2$ being 1.5×10^{-10} Joule, for γ=1, so for v = 0.
But this energy is still an order of magnitude higher than the presented peak value.
Besides that: if v = 0 the particle will not reach earth, given the chosen definition of v!

These observations present one the fundamental problem of the expression E = m$\boldsymbol{c}^2$: the velocity, on which the value of the mass is based, is not applicable for all energy measurements of cosmic rays.
All measured energies lower than 1.5×10^{-10} Joule have to be compared with the theoretical kinetic energy of the particle, expressed by $E = \frac{1}{2}m_{rest}v^2$, with v the velocity of the particle, relative to earth and in the appropriate direction, implicitly requiring a change of the definition of the reference for v.

Reference [2] writes: "*Fermi acceleration,............. , is the acceleration that charged particles undergo when being repeatedly reflected, ...*". The particle thus is assumed to be accelerated from a certain unknown velocity to a higher velocity, leading to the following two fundamental problems.

2 The violation of the axiom of conservation of mass *

The theory of relativity does not and can not explain how the increase of the mass of the cosmic particle, as function of its velocity, is realised in order to fulfil the axiom of conservation of mass.

3 The violation of the axiom of conservation of energy

The theory of relativity does not and can not explain how the increase of the energy of the cosmic particle, as function of its velocity, is realised in order to fulfil the axiom of conservation of energy.

Conclusions

1. The first fundamental problem measuring the energy of cosmic particles is that the results can not be compared unquestionably with theoretical results, due to the fact that the reference for the velocity v in the expression $1/\sqrt{(1-v^2/\boldsymbol{c}^2)}$ can not be defined unambiguously.
2. The second fundamental problem is that the interpretation of the measurements implies the violation of the axiom of conservation of mass.
3. The third fundamental problem is that the interpretation of the measurements implies the violation of the axiom of conservation of energy.
4. The moral question thus is: why would a sincere physicist defend E = m$\boldsymbol{c}^2$ as a realistic physical concept?

References

[1] https://en.wikipedia.org/wiki/Cosmic_ray

[2] https://en.wikipedia.org/wiki/Fermi_acceleration

[3] https://vixra.org/abs/1812.0357 Physics since Einstein, chapter XXIX: From Maxwell's equations to Electro-Magnetic Waves

* An axiom is a presumption of which its validity is strongly self-evident.