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

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

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: $1\text{-}v^2/c^2 = c^{-2}(c^2\text{-}v^2) = c^{-2}(c\text{-}v)*(c+v) \approx c^{-2}\ \varepsilon_v\ 2c = 2\varepsilon_v/c$, 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)....... "

v (m/s)	**γ**	**Joule**	**eV**	**specification**
0	1	$1.5*10^{-10}$	$9.6*10^{8}$	
$c/3$	1.06	$1.6*10^{-10}$	$1.0*10^{9}$	
$2c/3$	1.34	$2.1*10^{-10}$	$1.3*10^{9}$	
c – 135	1000	$1.6*10^{-7}$	$1.0*10^{12}$	CERN
c – 2.4	7872	$1.2*10^{-6}$	$7.5*10^{12}$	LHC
$c - 1.4*10^{-15}$	$3.3*10^{11}$	50	$3.1*10^{20}$	Oh-My-God

Table I Examples of theoretical energy levels of cosmic rays

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 to 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 energy

Up to now the reference for the velocity v of the particle has not been defined. Following the rules of the theory of relativity it has to be at least a so-called relativistic velocity.

Taking the earth as the reference for v, two non-relativistic velocities have to be defined: v_{ps} and v_{es}. For the ease of the discussion protons that enter earth in the plane of its orbit are considered. v_{ps} is defined as the velocity of the proton *relative to the sun*. v_{es} as $v_e \times \sin(2\pi rad/year \times t)$ relative to the sun too. v_e is about 3×10^4 m/s. In this configuration the non-relativistic velocity of the proton *relative to earth* is $\sim (v_{ps} + v_{es})$.

The relativistic velocity v is defined as $(v_{ps} + v_{es})/(1 + v_{ps}v_{es}/\boldsymbol{c}^2)$ and has to be equal to $\boldsymbol{c} - \varepsilon_v$, in order to measure the shown energies. At least in accordance to the theory of relativity.

Suppose $v_{ps} = \boldsymbol{c} - \Delta$ then $v = (\boldsymbol{c} - \Delta + v_{es})/(1 + (\boldsymbol{c} - \Delta)\, v_{es}/c^2) = \boldsymbol{c} - \varepsilon_v$. As a result $\Delta \sim \varepsilon_v(1+v_{es}/\boldsymbol{c}) \sim \varepsilon_v$.

Following consequently the rules of the theory of relativity this outcome shows that earth's velocity will not influence the measurements significantly.

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 that the lowest possible value of $\gamma m_{rest}\boldsymbol{c}^2$ is 1.5×10^{-10} J, for γ=1, so for v = 0. A velocity zero means that the related proton does not arrive at all at earth!

The classical kinetic energy E = ½mv^2 is 7.7×10^{-11} J for v = $\boldsymbol{c}$ and m = m_{rest}. So most cosmic rays apparently represent this energy. Besides that, energies between 7.7×10^{-11} and at least 1.5×10^{-10} J are, according to the theory of relativity (v < $\boldsymbol{c}$), impossible.

Such a conclusion doesn't sound like realistic physics.

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 most of the results are contrary to E = m$\boldsymbol{c}^2$ and can only be explained by E = ½mv^2. Besides that the consequence of this contradiction is that**,** according to the theory of relativity, energy levels between 7.7×10^{-11} and 1.5×10^{-10} J are impossible. That doesn't sound like realistic physics.
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:

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