Impact Factor (SJIF): 6.126 E-ISSN: 2583-1615

International Journal of Research in Academic World

Received: 15/January/2025 **IJRAW:** 2025; 4(2):36-39 **Accepted:** 22/February/2025

Kinetic Energy of Electron, Proton and Muon Explicitly Predicts No Family Change at Very High Energy with Relativistic Mass

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Abstract

We have been explicitly calculated the Einstein relativistic mass formula $m_{rel.} = \frac{m_0}{\sqrt{1-\frac{v^2}{c^2}}}$. Our calculation shows that we increase velocity of the electron, proton and muon. Our table and graph shows that a lepton could not make itself as Baryon or hadron. Because the electron velocity near light velocity (c) could not able to increase $E_{kinetic\ energy}(= \Delta E)$ mass energy equivalent to the mass energy of the proton. The proton has been much more ΔE mass energy in compare the electron. We have found the range for electron 0.1$\frac{v}{c}$to 0.9 $\frac{v}{c}$ that gives $E_{kinetic\ energy}$ the range from 0.0025 MeV to 2.0568 MeV. There the proton has provided $E_{kinetic\ energy}$ the range from 4.695 MeV to 3779.644 MeV (≈3.78 GeV). Our calculation and graph shows that it gives constraint on the massive particles who does not eligible to achieve velocity equal to light velocity $c = 3 \times 10^8\ m/sec(\ c \cong 1)$ and cannot change its flavor of family for example lepton to hadron.

Keywords: Rest mass, fermion, hadron, Kinetic energy and light velocity.

Introduction

In classical mechanics, momentum is mass time velocity. We want to extend this definition to the relativistic domain, but a question arises: Should we use ordinary velocity or proper velocity? In classical physics, they are same, so there is no a priori reason to favor one over the other. However, in the context of relativity it is essential that we use proper velocity, for the law of conservation of momentum would be inconsistent with the principal of relativity if we were to define momentum as $m_0\vec{v}$.

Thus

$$\vec{p} = \frac{m\vec{v}}{\sqrt{1-\frac{v^2}{c^2}}} \tag{1}$$

This is relativistic momentum.

Relativistic momentum is the spatial part of a 4-vector,

$$p^{\mu} = mv^{\mu} \tag{2}$$

and it is natural to ask what the temporal component,

$$p^0 = mv^0 = \frac{m_0 c}{\sqrt{1-\frac{v^2}{c^2}}} \tag{3}$$

Represents. Einstein called

$$m_{rel.} = \frac{m_0}{\sqrt{1-\frac{v^2}{c^2}}} \tag{4}$$

The relativistic mass ($p^0 = m_{rel.}c\ and\ \vec{p} = m_{rel.}\vec{v}$; m_0 itself was then called the rest mass and proper mass), but modern usage has abandoned this terminology in favor of relativistic energy:

$$E = \frac{m_0 c^2}{\sqrt{1-\frac{v^2}{c^2}}} \tag{5}$$

($p^0 = \frac{E}{c}$). Because p^0 is (apart from factor$\frac{1}{c}$) the relativistic energy, p^{μ} is called the energy-momentum 4-vector (or the momentum 4-vector, for short).

Notice that the relativistic energy is nonzero even when the object is stationary (cm frame of reference that has spatial 3-momenta equal to zero); we call this rest mass energy:

$$E_{rest} = m_0 c^2. \tag{6}$$

The remainder, which is attributable to the motion, we call kinetic energy

$$E_{kinetic} = E - m_0c^2 = \Delta E = m_0c^2\left(\frac{1}{\sqrt{1-\frac{v^2}{c^2}}} - 1\right) \tag{7}$$

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In the nonrelativistic regime ($v \ll c$) the square root will be expanded in powers of $\frac{v^2}{c^2}$, giving

$$E_{rel} = \frac{1}{2} m_0 v^2 + \frac{3}{8}\frac{m v^4}{c^2} + \cdots ; \qquad (8)$$

The leading term reproduces the classical formula. So far, this is all just notation. The physics resides in the experimental fact that E and $\vec{p}$, as defined by Equations (1) and (5), are conserved. In every closed (proper inertial frame or inertial cm frame) system, the total relativistic energy and momentum are conserved.

Planck Energy as a Limiting Case of Einstein Energy

It can been proven that Einstein's energy equation takes the following form (Einstein's quantum energy equation),

$$E = \frac{m_0 c^2}{\sqrt{1-\alpha\beta^2}} \qquad (9)$$

Where ($\beta = \frac{v}{c}$) is the ratio of the particle's velocity to the speed of light, ($0 \leq \alpha \leq 1$) is the particle's cohesion factor given by the relation,

$$\alpha = 1 - \frac{\hbar\Omega}{m_0 c^2} n \qquad (10)$$

Here we distinguish two limiting cases for the particle cohesion factor (α),

- Before any of the wave particles in the original particle vibrates ($n = 0 \Rrightarrow \alpha = 1$), the particle remains coherent and the energy equation (9) returns to Einstein's equation in special theory,

$$E = \frac{m_0 c^2}{\sqrt{1-\beta^2}} \qquad (11)$$

- While if all the wave particles in the original particle vibrate ($n = N \Rrightarrow \alpha = 0$), the particle becomes an elastic medium and the energy equation (9) turns into Planck's equation,

$$E = N\hbar\boldsymbol{\Omega} = m_0 c^2 \qquad (12)$$

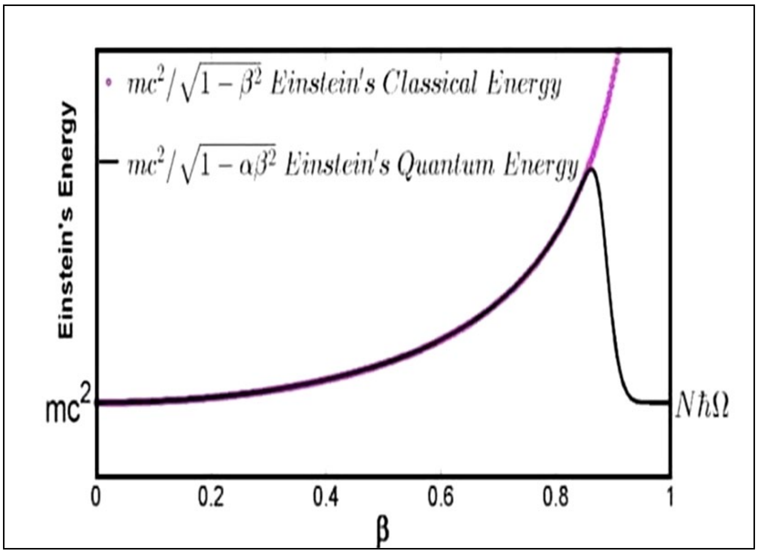

Fig 1: $\beta\left(\frac{v}{c}\right)$ *relativistic velocity and* mc^2 *rest mass energy MeV.*

Objective

We have been explored relativistic mass energy equivalence parameter. The study has shown that the lepton and hadron family could not mixed at very high energy or around light velocity c. We calculated E kinetic energy, m/m₀ and v/c parameters. We have also shown that our graphs and tables have been cohesion to explain about the high-energy limit.

- **Electron rest mass m_0= 0.511 MeV,**

We make first calculation in our table. It shows number of parameters respectively: $\beta = \frac{v}{c}$, velocity (v)has range from 0.1 c to 0.9 c.We have explored velocity at high energy in particular 0.91 c, 0.92 c, 0.93 c, 0.94 c and 0.98 c. We have calculated $\frac{m}{m_0} = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{1}{\sqrt{1-\beta^2}}$. It has range from 1.0050 to 5.02518. We have calculated $m_{rel.} = m_0 \frac{1}{\sqrt{1-\beta^2}}$. It has range from 0.51357 MeV to 2.56787 MeV. We have calculated $\Delta m = m_{rel.} - m_0$. This presents kinetic energy $E_{kinetic} = \Delta mc^2$ also. It has range 0.0025 MeV and 2.0568 MeV.

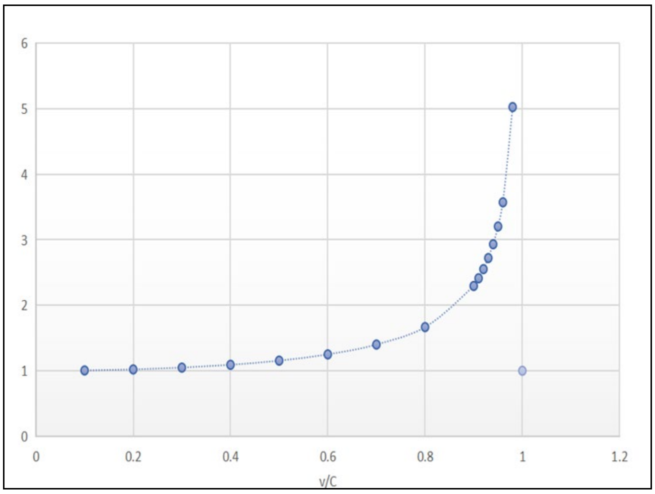

Fig 2: Relativistic mass increase with particles velocity increase.

Above relativistic mass increase graph has accepted for the lepton, hadron and all other ion elements. It shows that every charge particle at high energy gets itself a relativistic mass. Which has range for $\frac{m}{m_0}$ from 1.005 to 5.025 end so on. We have calculated separate parameter E kinetic energy, which can help us to show very clean that no family should be change at very high energy. We know that increase in mass of electron at very high energy, which could not be increase as much as the proton or hadrons. Below our table, we compare $E_{kinetic}$ energy or fermion and hadrons.

Table 1: ν velocity near 0.98c the $E_{kinetic}$ of electron, muon and proton.

S. No.	$\frac{v}{c}$	$\frac{m\ (MeV)}{m_0(MeV)}$	$E_{kinetic}$ (electron) MeV	$E_{kinetic}$ (μ muon) MeV	$E_{kinetic}$ (μ muon) GeV	$E_{kinetic}$ (proton) MeV	$E_{kinetic}$ (proton) GeV
1	0.1c	1.005	0.0025 MeV	0.5285 MeV	0.0005285 GeV	4.695 MeV	0.004695 GeV
2	0.2c	1.0206	0.0105 MeV	2.7482 MeV	0.0027482 GeV	19.3434 MeV	0.0193434 GeV
3	0.3c	1.04828	0.02467 MeV	5.103196 MeV	0.005103196 GeV	45.33492 MeV	0.0453349 GeV
4	0.4c	1.091	0.04654 MeV	9.6281 MeV	0.0096281 GeV	85.532571 MeV	0.085532571 GeV
5	0.5c	1.1547	0.07905 MeV	16.35179 MeV	0.01635179 GeV	145.2633 MeV	0.1452633 GeV
6	0.6c	1.25	0.12775 MeV	26.425 MeV	0.026425 GeV	234.75 MeV	0.23475 GeV
7	0.7c	1.4002	0.20454 MeV	42.3095 MeV	0.0423095 GeV	375.8629 MeV	0.3758629 GeV
8	0.8c	1.6666	0.34066 MeV	70.45962 MeV	0.07045962 GeV	625.993 MeV	0.625993 GeV
9	0.9c	2.2941	0.661314 MeV	136.7923 MeV	0.1367923 GeV	1215.2134 MeV	1.2152134 GeV
10	0.91c	2.4119	0.72148 MeV	149.2388 MeV	0.1492388 GeV	1325.7834 MeV	1.3257834 GeV
11	0.92c	2.5515	0.79284 MeV	163.9988 MeV	0.1639988 GeV	1456.9054 MeV	1.4569054 GeV
12	0.93c	2.7206	0.8792 MeV	181.87164 MeV	0.18187164 GeV	1615.6809 MeV	1.6156809 GeV
13	0.94c	2.931	0.98676 MeV	204.1119 MeV	0.2041119 GeV	1813.2559 MeV	1.8132529 GeV
14	0.95c	3.2025	1.1255 MeV	232.81 MeV	0.23281 GeV	2068.20665 MeV	2.06820665 GeV
15	0.96c	3.5714	1.314 MeV	271.7999 MeV	0.2717999 GeV	2414.57089 MeV	2.41457089 GeV
16	0.98c	5.0251	2.0568 MeV	425.4615 MeV	0.4254615 GeV	3779.64402 MeV	3.7796402 GeV

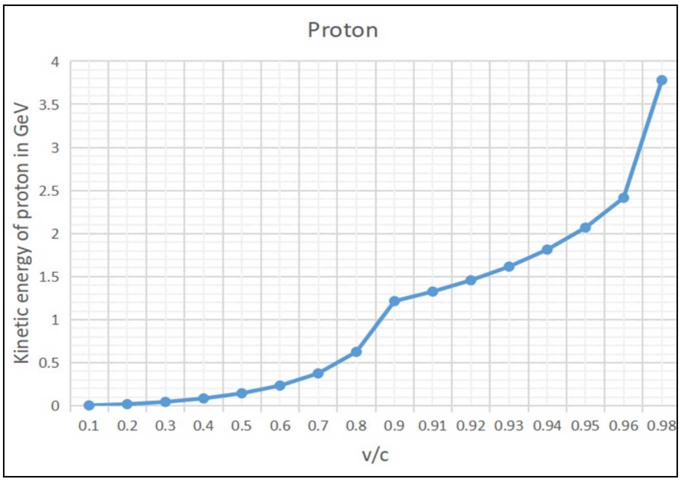

Fig 3: *ΔE kinetic energy of proton and relativistic velocity of proton* $\frac{v}{c}$.

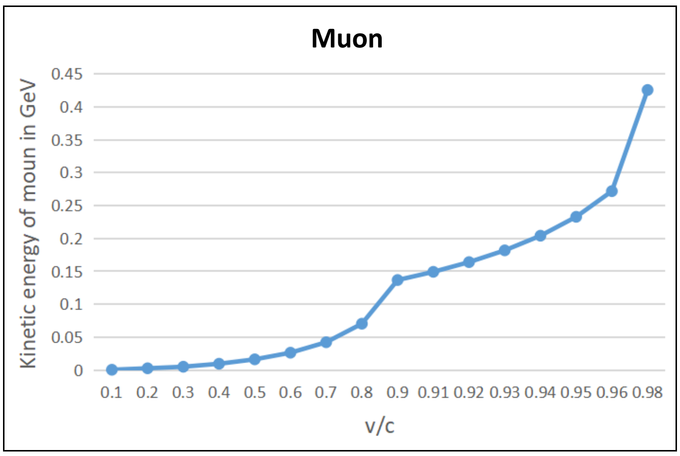

Fig 4: *ΔE kinetic energy of muon and relativistic velocity of muon* $\frac{v}{c}$.

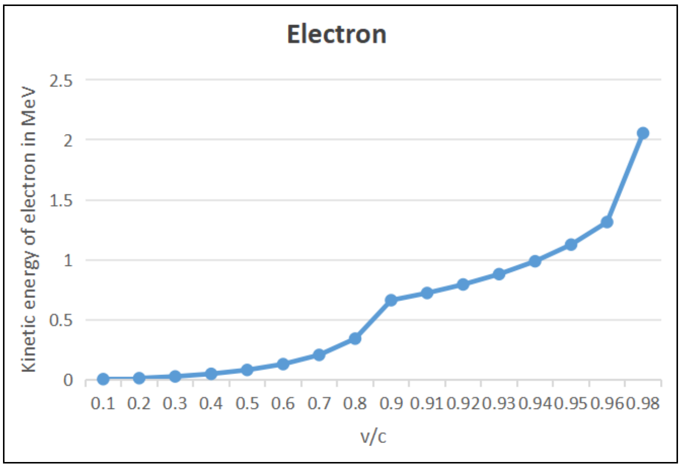

Fig 5: *ΔE kinetic energy of electron and relativistic velocity of electron* $\frac{v}{c}$.

We observe that at very high energy or particles velocities around v =0.98 c gets $E_{kinetic\ energy}$ of the electron 2.0568 MeV, the muon 0.4254615 GeV and the proton 3.7796402 GeV. This order reflects that lepton could not able to reach $\approx 4\ GeV$ at the v =0.98 c which is getting by hadron alike proton. There is no change a lepton family to hadron family.

Result

We concluded that around speed of light charge particle's relativistic mass very much has increased. We focus and conclusion that lepton has become heavy but they could not heavy such as hadron relativistic mass. This point can help to understand lepton family and hadron family has separate relativistic mass order around v =0.98 c velocity that is the lepton $E_{kinetic\ energy}$ ≈0.5 GeV and the hadron $E_{kinetic\ energy} \geq 4GeV$.

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