Neutrino Mass and Energy Obeying Heracletean Dynamics (Third time's a charm)

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Abstract: *Neutrino mass and energy have been related with the help of Heracletean dynamics of the ordinary matter taking into account the dynamics constant k = hc.*

Keywords: *Heracletean dynamics, neutrino real, zero and imaginary ground mass, neutrino relativistic energy at the speed of light*

1. INTRODUCTION

Previously one concluded that obeying Heracletean dynamics – expressed as F = dp/dt + d(k/p)/dt – a neutrino ground mass could be very small or even zero. [1] In this paper for the neutrino ground mass calculation the dynamics constant $k = hc$ will be taken into account as predicted for the variant ordinary matter [2].

2. THE RELATIVISTIC MASS

In Heracletean dynamics the relativistic equation for mass of the ordinary matter is the next [2]:

$$m^2 c^2 a^2 = e^{\frac{m_0^2 c^2 - hc(1 - lnhc) + m^2 c^2 (a^2 - 1)}{hc}}. \tag{1}$$

Where m = relativistic mass, m_0 = ground mass, h = Planck constant, c = speed of light, and a = speed of a physical body expressed in the units of the speed of light.

3. THE RELATIVISTIC MASS AT THE SPEED OF LIGHT

For the relativistic mass of physical body traveling at the speed of light (a = 1) the relativistic equation (1) is simplified:

$$m^2 c^2 = e^{\frac{m_0^2 c^2 - hc(1 - lnhc)}{hc}}. \tag{2}$$

And for the relativistic mass of physical body of the zero ground mass (m_o = 0) traveling at the speed of light (a = 1) the equation (1) is further simplified so that the relativistic mass m and the corresponding relativistic energy $E = mc^2$ can be easily calculated as follows:

$$m = \frac{\sqrt{e^{lnhc-1}}}{c} = \sqrt{\frac{h}{ec}} = 9{,}017\ 173\ 347\ x\ 10^{-22} kg. \tag{3a}$$

And

$$E = \sqrt{\frac{hc^3}{e}} = 0.5\ PeV. \tag{3b}$$

Greater relativistic energy than $E = 0.5\ PeV$ of a physical body at the speed of light belongs to a real ground mass:

$$m_0 \in \mathbb{R} \rightarrow E > 0.5\ PeV. \tag{4}$$

And smaller relativistic energy than $E = 0.5\ PeV$ of a physical body at the speed of light belongs to an imaginary ground mass:

$$m_0 \in \mathbb{R}i \rightarrow E < 0.5\ PeV. \tag{5}$$

4. THE NEUTRINO RELATIVISTIC ENERGY RELATED TO NEUTRINO GROUND MASS

Neutrino relativistic energy at the speed of light expands from *eV* to *EeV* covering by origin various neutrinos such as Big Bang, Terrestrial, Reactor, Solar, Super Nova, Atmospheric, Accelerator, Galactic and Extra Galactic ones. [3] Till now 2 PeV is probably the highest energy of neutrino observed [4]. For such high energetic neutrinos of $E > 0.5\ PeV$ a real ground mass is expected. Otherwise [3] an imaginary ground mass is supposed to be mostly characteristic of neutrinos in Heracletean dynamics.

5. THE IMAGINARY NEUTRINO GROUND MASS IMPLYING THE IMAGINARY GROUND SPEED

According to the relation $v_o = \frac{\sqrt{hc}}{m_o}$ [5] an imaginary ground mass m_o implies an imaginary ground speed v_o:

$$If\ m_0 \in \mathbb{R}^+i \rightarrow v_0 \in \mathbb{R}^-i. \tag{6a}$$

And according to the relation $\lambda_{Compton} = v_0\ t_0$ an imaginary ground speed $v_o \in \mathbb{R}^-i$ implies

a) Two possibilities of a path on imaginary Compton wave length of the neutrino in a real time:

$$\lambda_{Compton} \in \mathbb{R}^-i\ \ and\ t_0 \in R^+,$$

$$\lambda_{Compton} \in \mathbb{R}^+i\ \ and\ t_0 \in R^-. \tag{6b}$$

And

b) Two possibilities of a path on real Compton wave length of the neutrino in an imaginary time:

$$\lambda_{Compton} \in \mathbb{R}^+\ \ and\ t_0 \in \mathbb{R}^-i,$$

$$\lambda_{Compton} \in \mathbb{R}^-\ \ and\ t_0 \in \mathbb{R}^+i. \tag{6c}$$

What only means that a neutrino of an imaginary ground mass eagerly wait in front of the door of real space and time to enter with a superluminal speed into existence. To actually enter the input of energy is needed since the relativistic energy of such neutrinos is in inverse proportion to speed. And to become a visible neutrino the further input of energy is needed to slow down the neutrino superluminal speed to the speed of light. And contrarily, to embrace the so called neutrino slowdown energy means to allow the neutrino to go back to the superluminal world without that energy.

Figure1. *To embrace neutrino energy*

6. THE REAL NEUTRINO GROUND MASS WITH SUPERLUMINAL GROUND SPEED

The neutrinos of real ground mass are of course here already now. But to become visible in their existence - similar to the case of neutrinos of an imaginary ground mass - the input of energy is

needed, too, to slow down the superluminal speed to the speed of light in the case where their ground speed is superluminal ($v_0 > c$). This applies – according to the relation $m_o = \frac{\sqrt{hc}}{v_o}$ [5] and the equation (3a) – for the neutrino ground mass in the next range:

$$\sqrt{\frac{h}{c}} > m_0 > 0. \tag{7}$$

And according to the equation (2) it applies for the neutrino relativistic mass and energy at the speed of light in the next range:

$$\sqrt{\frac{h}{c}} > m > \sqrt{\frac{h}{ec}}, \tag{8a}$$

$$0.8 \, PeV > E > 0.5 \, PeV. \tag{8b}$$

So these values belong to Heracletean micro world of low ground mass, i.e.: $m_0 < \sqrt{\frac{h}{c}}$ where the wave nature of matter prevails over the physical body nature [5].

7. THE REAL NEUTRINO GROUND MASS WITH SUBLUMINAL GROUND SPEED

The neutrinos of real ground mass greater than $m_0 = \sqrt{\frac{h}{c}}$ (7) and relativistic energy at the speed of light greater than E = 0.8 PeV (8) are visible because of their subluminal ground speed. Such ground masses are a part of macro world [5] where input of energy is needed to reach the speed of light.

8. CONCLUSION

Respecting Heracletean dynamics taking into account the dynamics constant $k = hc$ neutrinos can possess an imaginary, zero and a real ground mass. They behave according to the micro or macro world to which they belong.

DEDICATION

This fragment is dedicated to the Charm of Being and the song of Jacques Brel: "Ne me quitte pas"

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