Symmetry of mass and energy density of quantum vacuum

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Abstract

Mass is an energy form of quantum vacuum in symmetry with diminished energy density of quantum vacuum. Presence of mass diminishes energy density of quantum vacuum respectively to the energy of a given mass. A given particle with a mass diminishes energy density of quantum vacuum, mass-less particle does not diminish energy of quantum vacuum. In order to explain mass of elementary particles this view does not require existence of the hypothetical boson of Higgs.

Key words: mass, quantum vacuum, energy density of quantum vacuum, Higgs boson.

1. Introduction

Planck density is: $\rho_p = \frac{m_p}{l_p^3}$ (1) where m_p is Planck mass and l_p is Planck length.

Planck energy is: $E_p = m_p * c^2$ (2) where c is the speed of light. Planck energy density is: $\rho_{pE} = \frac{m_p * c^2}{l_p^3} = \frac{2{,}1767 \cdot 10^{-8} \cdot \left(3 \cdot 10^8\right)^2}{\left(1{,}6161 \cdot 10^{-35}\right)^3} = \frac{1{,}95903 \cdot 10^9}{4{,}22090 \cdot 10^{-105}} = 4{,}64126 \cdot 10^{97} \frac{Kg}{ms^2}$ (3).

Out of (3) follows in empty cosmic space without mass density of energy of a given volume of quantum vacuum V_{qv} is $\rho_{qvE} = \frac{\sum_1^n m_p * c^2}{\sum_1^n l_p^3}$ (4), where $V_{qv} = \sum_1^n l_p^3$ (5).

Out of (4) and (5) follows: $\rho_{qvE} = \rho_{pE}$ (6).

By the presence of a given massive particle or massive object m in an empty quantum vacuum its energy density $\rho_{qvE}=\rho_{pE}$ will diminish in the centre of mass m respectively to the amount of mass m and its volume V :

$\rho_{qvE}=\rho_{pE}-\frac{m*c^2}{V}$ (7) where $V=\frac{4}{3}*\pi*r^3$ (8) and r is a radius of massive particle or massive object m .

Out of (7) and (8) follows:

$$\rho_{qvE}-\rho_{pE}=-\frac{3m*c^2}{4\pi*r^3}$$

namely $\rho_{pE}-\rho_{qvE}=\frac{3m*c^2}{4\pi*r^3}$

namely $\Delta\rho_{qvE}=\frac{3m*c^2}{4\pi*r^3}$ (9).

Formalism (9) describes symmetry between mass m and energy density of quantum vacuum. Equation (9) suggests that the physical property of mass derives from a change of the energy density of quantum vacuum: each material object endowed with mass is produced by a change of the energy density of quantum vacuum on the basis of equation $m=\frac{4\pi r^3\Delta\rho_{qvE}}{3c^2}$ (10). Therefore, we can say that, in this approach, mass has its origin into diminished density of energy of quantum vacuum. This view does not require existence of hypothetical bosons of Higgs [1,2,3]. Moreover, out of equation (9) it follows by mass-less particle $\Delta\rho_{qvE}=0$ (11).

2. Energy density of quantum vacuum inside Schwarzschild radius

Energy density $\Delta\rho_{qvEC}$ inside Schwarzschild is derived from the formalism (9) where m is 3,2 mass of the sun and r is Schwarzschild radius $r_s=\frac{2Gm_S}{c^2}$ where m_S is the mass of the sun and G is gravitational constant:

$$\Delta\rho_{qvEC}=\frac{9{,}6m_S*c^2}{4\pi*\left(\frac{2Gm_s}{c^2}\right)^3}=\frac{9{,}6m_S*c^2}{\frac{4\pi*8G^3*m_S^3}{c^8}}=\frac{9{,}6*c^{10}}{4\pi*8G^3*m_S^2} \quad (12)$$

$$\Delta\rho_{qvEC}=\frac{9{,}6*(3*10^8)^{10}}{4*3{,}14*8*\left(6{,}67*10^{-11}\right)^3*\left(1{,}98892*10^{30}\right)^2}$$

$$\Delta\rho_{qvEC}=\frac{5{,}66870*10^{85}}{1{,}17948*10^{32}}=4{,}80610*10^{53}\frac{Kg}{ms^2}$$

The difference between ρ_{pE} and $\Delta\rho_{qvEC}$ is called "critical energy density of quantum vacuum" ρ_{qvEC}:

$\rho_{qvEC}=\rho_{pE}-\Delta\rho_{qvEC}$ (13).

$$\rho_{qvEC}=4{,}64126\cdot10^{97}\frac{Kg}{ms^2}-4{,}80610*10^{53}\frac{Kg}{ms^2}$$

Inside Schwarzschild radius energy density of quantum vacuum is approximately $\rho_{qvEC}\approx 4{,}725\cdot10^{44}\frac{kg}{ms^2}$. According to the interpretation here energy density of quantum vacuum inside Schwarzschild radius is so low that cannot support structure of massive particles, so massive particles will collapse into quantum vacuum itself, namely will disintegrate into the quantum vacuum itself.

3. Energy of mass and energy of quantum vacuum seems to be in dynamic equilibrium

According to the first law of thermodynamics the sum of energy of mass E_m and quantum vacuum energy E_{qv} in the universe is constant:

$$\sum E_m+\sum E_{qv}=K \quad (14).$$

In areas where energy density of quantum vacuum is below ρ_{qvEC} as in black holes inside Schwarzschild radius mass is transforming into energy of quantum vacuum. In

outer space where energy density is at the maximum ρ_{pE} energy of quantum vacuum is transforming into elementary particles with mass. Idea of permanent appearance of massive particles from outer space is present in cosmology since year 2000 [4]. In this view circulation of energy "mass – quantum vacuum – mass" is permanent. In the universe energy of mass and energy of quantum vacuum are in a dynamic equilibrium.

4. Conclusions

Mass and quantum vacuum as a medium into which mass exist are inseparable physical entities and cannot be approached separately. Mass is an energy form of quantum vacuum in symmetry with diminished density of energy of quantum vacuum. This view does not require existence of hypothetical bosons of Higgs and opens new perspectives into transformation of mass inside Schwarzschild radius and appearance of mass in outer cosmic space.

References:

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