Enlarged Formula $E = mc^2$

Origin of inertial mass and of gravitational mass

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Abstract

Energy of every physical object from the micro to the macro scale is the structured energy of quantum vacuum. The energy density in the centre of a given physical object is diminishing correspondently to the amount of the energy of a given physical object. A given physical object cannot be examined without the quantum vacuum in which it exists. There is an intrinsic relation between origin of inertial mass, gravitational mass of a given physical object and diminished energy of quantum vacuum in the centre of the object.

Key words: variable energy density of quantum vacuum, mass, inertial mass, gravitational mass

1. Introduction

In empty space energy density of quantum vacuum has the value of Planck energy density ρ_{PE}**:**

$$\rho_{PE} = \frac{m_P \cdot c^2}{V_P} \qquad (1)$$

A given physical object is diminishing Planck energy density in its centre according to the following formula:

$$\rho_{qvE} = \rho_{PE} - \frac{mc^2}{V} \qquad (2),$$

where ρ_{qvE} is the energy density of quantum vacuum in the centre of the elementary particle or massive body, V is the volume of particle or massive body, ρ_{PE} is Planck energy density.

Out of formula (2) we can get:

$$\frac{(\rho_{PE} - \rho_{qvE}) \cdot V}{c^2} = m \qquad (3),$$

where m is the mass and represents the amount of energy of quantum vacuum which is structured in a given particle or massive body.

Out of (3) we can get:

$$(\rho_{PE} - \rho_{qvE}) \cdot V = mc^2 \quad (4).$$

Out of (4) we get enlarged Einstein formula:

$$E = mc^2 = (\rho_{PE} - \rho_{qvE}) \cdot V \quad (5).$$

The right side is the missing part of the Einstein formula and is expressing relation between energy/mass of the physical object and diminished energy density of quantum vacuum in its centre. In formula (5), m represents the amount of energy of quantum vacuum, which is structured in a given particle or massive body. Higher energy density of quantum vacuum is pushing towards the centre of a given particle or massive body where energy density is lower. This difference between outer and inner energy density generates inertial mass and gravitational mass of a given particle or massive body. Mass m of a given particle or massive body is the amount of energy we measure with inertial mass m_i or gravitational mass m_g . It is valid:

$$m = m_i = m_g$$

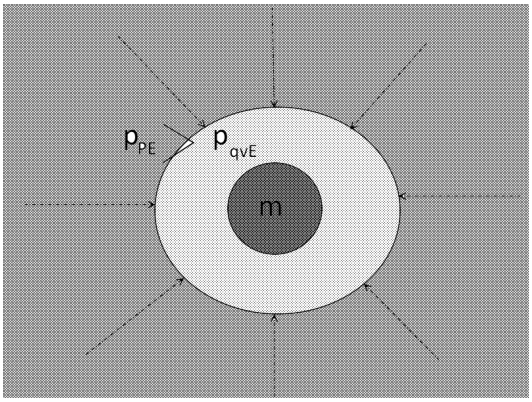

Figure 1: Origin of inertial mass and of gravitational mass

In the formula $F_g = \frac{m_1 \cdot m_2 \cdot G}{r^2}$ we can see that mass m_1 and mass m_2 have origin in diminished energy density of quantum vacuum inside of a given material objects.

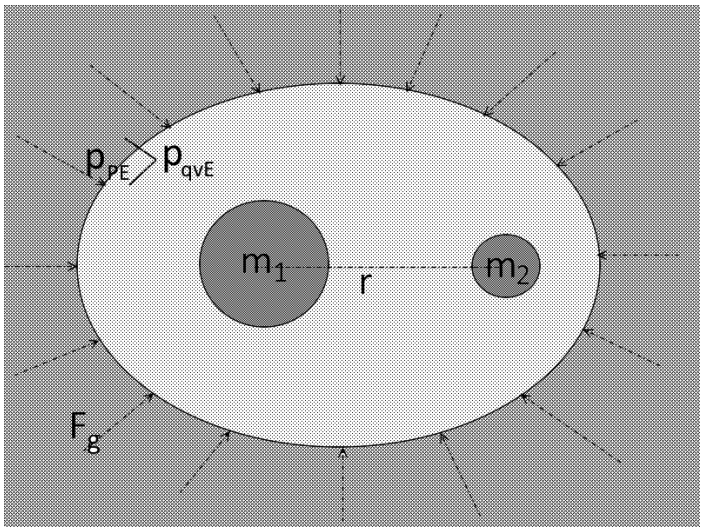

Figure 2: Origin of gravity

Gravity force is pushing together material objects m_1 and m_2. There is no hypothetical graviton that would carry attraction force between material objects.

In Unified Physics relativistic particle or massive body is increasing its energy and mass because it is additionally integrating energy of quantum vacuum. Kinetic energy is additional energy of quantum vacuum structured in a fast moving particle or massive body.
In physics literature Relativistic energy of a moving physical object is often defined with following formula:

$$E = m_0 c^2 + \frac{1}{2} m_0 v^2 \qquad (6).$$

In Advanced Relativity formula (5) is written as follows:

$$E = m_0 c^2 + \frac{1}{2} m_0 v^2 = m_0 c^2 \cdot \gamma_{AR} = E_0 \cdot \gamma_{AR} \qquad (7),$$

where γ_{AR} is the Advanced Relativity factor and E_0 is energy of the physical object at the rest.

Formula (6) we can divide with $m_0 c^2$ and we get formula for Advanced Relativity relativistic factor:

$$\gamma_{AR} = 1 + \frac{m_0 v^2}{2 m_0 c^2} \qquad (8).$$

Formula (8) we can write as following:

$$\gamma_{AR} = 1 + \frac{v^2}{2c^2} \quad (9).$$

Combining formulas (7) and (9) we get:

$$E = E_0 \cdot (1 + \frac{v^2}{2c^2}) \quad (10).$$

$$E = E_0 + E_0 \frac{v^2}{2c^2} \quad (11).$$

When v is zero, $E = E_0$. When $v = c$, $E = E_0 + \frac{E_0}{2}$.