The Normalized Relativistic Factor: the Leonov's Factor

Professor Vladimir Leonov

Abstract. Relativistic factor γ relate to the theory of relativity. The fact of the unification of the theory of relativity and quantum theory takes place in the theory of quantum gravitation as a part of the theory of Superunification [1, 2]. Therefore, it became possible for us to relate the region of relativism to quantum physics. The main problem of relativism is the problem of infinite values of mass and energy during the acceleration of an elementary particle to the speed of light. We solved this problem by introducing a normalized relativistic factor - the Leonov's factor which was introduced into theoretical physics after the discovery of the quanton in 1996. The normalized relativistic factor limits the upper limit of the mass and energy of relativistic particles and excludes infinity. So, a proton when reaching the speed of light should have a limited mass equal to the mass of an iron asteroid with a diameter of 1 km. When the speed of light is reached, the relativistic particle passes into the state of the relativistic black micro-hole, limiting its parameters.
Keywords: normalized relativistic factor, theory of Superunification, quanton, black micro-hole.

The experiments show that the mass of the particle m increases with increasing speed v of the particle, and this increase is especially large in the region of relativistic speed, close to the speed of light C:

$$m = \gamma m_o = \frac{m_o}{\sqrt{1 - \frac{v^2}{C_o^2}}} \tag{1}$$

where m_o is rest mass, kg;

$C_o^2 = 9\cdot 10^{16}$ J/kg is gravitational potential of undeformed quantized space-time;

γ is a known relativistic factor:

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{C_o^2}}} \tag{2}$$

However, a shortcoming of (1) is that the mass of the particle increases to infinity with the increase of the speed v of the particle to the speed of light C_0. This can be regarded as true if the quantized space-time itself were not characterized by the limiting parameters, including the finite value of the speed of light C_0 which is not limitless. This means that the relativistic particles, even when they reach the speed of light, should have limiting finite but not infinite parameters.

We write the classical Poisson equation for gravitational potentials φ:

$$\mathrm{div}(\mathrm{grad}\varphi) = 4\pi G\rho_m \tag{3}$$

where $G = 6.67 \cdot 10^{-11}$ Nm^2/kg^2 is gravitational constant;

ρ_m is the density of matter, kg/m^3.

We can write a two-component solution of the Poisson equation (4) for gravitational potentials:

$$\begin{cases} \varphi_1 = C^2 = C_o^2\left(1 - \dfrac{R_g}{r}\right) \text{ при } r \ge R_S \\ \varphi_2 = C_o^2\left(1 + \dfrac{R_g}{R_S}\right) \end{cases} \tag{4}$$

where φ_1 and φ_2 are the distribution functions of the gravitation potential for the spherically deformed space-time, J/kg;

C^2 is gravitational potential of the action, J/kg;

R_S is radius of the gravitational boundery (the interface) between the regions of tension and compression (radius of the particle, body), m;

r is distance, m;

R_g is gravitational radius (without multiplier 2), m:

$$R_g = \frac{Gm}{C_o^2} \tag{5}$$

From (4), taking into account (5), we find the balance of gravitational potentials for an elementary particle inside quantized space-time:

$$C^2 = C_o^2 - \varphi_n \tag{6}$$

where φ_n is Newtonian gravitational potential:

$$\varphi_n = \frac{Gm}{r} \tag{7}$$

The balance of gravitational potentials (6) is the balance in statics. Next, we write down the balance of gravitational potentials (6) in dynamics taking into account the relativistic factor γ (2):

$$C^2 = C_o^2 - \gamma\varphi_n = C_o^2 - \frac{\varphi_n}{\sqrt{1 - \dfrac{v^2}{C_o^2}}} \tag{8}$$

In the limiting case, with increasing particle velocity v to the speed C_o of light, the Newtonian potential should not exceed C_o^2. For this purpose, we introduce in (8) a normalization coefficient k_n that limits the parameters of relativistic particles:

$$C^2 = C_o^2 - \frac{\varphi_n}{\sqrt{1 - k_n \frac{v^2}{C_o^2}}} \tag{9}$$

The normalization relativistic factor γ_n is included in (9):

$$\gamma_n = \frac{1}{\sqrt{1 - k_n \frac{C_o^2}{C_o^2}}} \tag{10}$$

In the limiting case the gravitational potential of the action C^2 (9) is equal to 0 when the relativistic particle reaches the speed of light $v = C_o$:

$$C^2 = C_o^2 - \frac{\varphi_n}{\sqrt{1 - k_n \frac{C_o^2}{C_o^2}}} = 0 \tag{11}$$

From (11) we find a number of solutions:

$$\frac{\varphi_n}{\sqrt{1 - k_n}} = C_o^2 \tag{12}$$

$$\frac{\varphi_n}{C_o^2} = \sqrt{1 - k_n} \tag{13}$$

We substitute in (13) from (11):

$$\frac{Gm}{C_o^2 R_S} = \sqrt{1 - k_n} \tag{14}$$

In view of (5), from (14) we obtain:

$$\sqrt{1 - k_n} = \frac{R_g}{R_S} = \tag{15}$$

From (15) we finally get the normalization coefficient k_n:

$$k_n = 1 - \frac{R_g^2}{R_S^2} \tag{16}$$

Substituting (16) in (10) we obtain the formula for the normalized relativistic factor γ_n - the Leonov's factor:

$$\gamma_n = \frac{1}{\sqrt{1 - \left(1 - \frac{R_g^2}{R_S^2}\right) \frac{C_o^2}{C_o^2}}} \tag{17}$$

Now we can correct the formula of relativistic mass (1) and energy W using the normalized relativistic factor (17):

$$m = \gamma_n m_o = \frac{m_o}{\sqrt{1 - \left(1 - \frac{R_g^2}{R_S^2}\right)\frac{v^2}{C_o^2}}} \tag{18}$$

$$W = \gamma_n W_o = \frac{W_o}{\sqrt{1 - \left(1 - \frac{R_g^2}{R_S^2}\right)\frac{v^2}{C_o^2}}} \tag{19}$$

The normalized relativistic factor limits the upper limit of the mass and energy of relativistic particles and excludes infinity. So, a proton when reaching the speed of light should have a limited mass equal to the mass of an iron asteroid with a diameter of 1 km. When the speed of light is reached, the relativistic particle passes into the state of the relativistic black micro-hole, limiting its parameters [1-5].

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