The Formula of the Speed of Light in a Quantized Space-Time

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Abstract. There is Einstein's formula of 1911 which shows that the speed of light is not a constant, but it is a function of the gravitational potential [1]. This formula is not written correctly because the speed of light c enters the left and right sides of the formula. At that time, Einstein did not know that space-time is quantized space-time and it has its own gravitational potential equal to the square of the speed of light. This fact was established by me in 1996 [2, 3]. In the theory of Superunification, the formula of the speed of light is a very simple formula and it is equal to the square root of the gravitational action potential or it is equal to the square root of the quantum density of quantized space-time.

Keywords: speed of light, theory of Superunification, gravitational action potential, quantum density, quantized space-time.

There is Einstein's formula of 1911 which shows that the speed of light C is not a constant, but it is a function of the gravitational potential φ [1];

$$C = C_o\left(1 + \frac{\varphi}{C^2}\right) \qquad (1)$$

where C_o is the speed of light in the absence of gravity, m/s.

This formula is not written correctly because the speed of light C enters the left and right sides of the formula.

In the theory of Superunification, a quantized space-time is described by the gravitational action potential φ_1 [4]:

$$\varphi_1 = C^2 \qquad (2)$$

From (2) we find the speed of light C in quantized space-time:

$$C = \sqrt{\varphi_1} \qquad (3)$$

where φ_1=f (x, y, z) is the coordinate function: x, y, z.

The gravitational action potential φ_1 is an analog of the quantum density ρ_1 of the medium [5]:

$$\varphi_1 = C^2 = C_o^2\frac{\rho_1}{\rho_o} \qquad (4)$$

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

ρ_o is quantum density of undeformed quantized space-time, q/m^3.

We substitute (4) in (3):

$$C = \sqrt{\varphi_1} = C_o\sqrt{\frac{\rho_1}{\rho_o}} \qquad (5)$$

For a spherically deformed of the quantized space-time, we have a distribution function of the quantum density ρ_1 of the medium and gravitational action potentials φ_1 [6]:

$$\rho_1 = \rho_o\left(1 - \frac{R_g}{r}\right) \text{ at } r \geq R_S \tag{6}$$

$$\varphi_1 = C^2 = C_o^2\left(1 - \frac{R_g}{r}\right) \text{ при } r \geq R_S \tag{7}$$

where 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:

$$R_g = \frac{Gm}{C_o^2} \tag{8}$$

where $G = 6.67 \cdot 10^{-11}$ Nm^2/kg^2 is gravitational constant;
m is mass, kg;
We substitute (6) in (5) and (7) in (3):

$$C = \sqrt{\varphi_1} = C_o\sqrt{\frac{\rho_1}{\rho_o}} = C_o\sqrt{\left(1 - \frac{R_g}{r}\right)} \tag{9}$$

$$C = \sqrt{\varphi_1} = C_o\sqrt{\left(1 - \frac{R_g}{r}\right)} \tag{10}$$

Light speed formulas (9) and (10) are equivalent to each other. We substitute (8) in (10):

$$C = \sqrt{\varphi_1} = C_o\sqrt{\left(1 - \frac{Gm}{rC_o^2}\right)} = \sqrt{\left(C_o^2 - \frac{Gm}{r}\right)} \tag{11}$$

Analysis of the speed of light C (11) in quantized space-time perturbed by gravity shows that with increasing mass m the speed of light decreases in its vicinity. In a strong gravitational field on the surface of a black hole at $r = R_g$ (10), we have a complete stop of light and its speed is zero [7]:

$$C = \sqrt{\varphi_1} = C_o\sqrt{\left(1 - \frac{R_g}{R_g}\right)} = 0 \tag{12}$$

In the weak gravitational field of the Earth, we have a decrease in the speed of light by 0.1 m/s at $C_o = 299792458\ \text{м/с}$. The deceleration of the speed of light with the gravitational field of the Sun at its surface is more than 321 m/s, due to its stronger action

At relativistic speeds v, we need to consider the normalized relativistic factor γ_n [8]:

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

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

$$C = C_o\sqrt{\left(1-\frac{\gamma_n R_g}{r}\right)} \tag{18}$$

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