The square of the speed of light is the gravitational potential of quantized space-time in the theory of Superunification

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In 1996, I introduced the quantum of space-time (quanton) into theoretical physics in the form of electromagnetic quadrupole. It was a particle unknown in science before. Quanton is a carrier of superstrong electromagnetic interaction (SEI). This is the fifth fundamental interaction in nature unknown before. SEI unites four fundamental interactions: gravitation, electromagnetism, nuclear and electroweak forces. Quanton and SIA are the basis of the fundamental theory of Superunification [2]. Quanton is a four-dimensional particle that forms the electromagnetic structure of Einstein's four-dimensional space-time. SIA is a hidden form of the global energy field of the Universe, which is characterized by a gravitational potential equal to the square of the speed of light.

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To have the opportunity for further development of Einstein's theory of General Relativity (GR) it is necessary to find a replacement for geometric invariant ds^2, which is based on the Pythagorean Theorem in rectangular $(ds^2 = dx_1^2 + dx_2^2 + dx_3^2 - dx_4^2)$ and curvilinear coordinates $(ds^2 = g_{ik}dx_i dx_k)$ [1]. The gravitational potential C^2 is best suited for this functionality among all the known parameters of the four-dimensional space-time. But the gravitational potential C^2 is not a square of the speed of light C. On the contrary, the speed of light C is a square root of the gravitational potential C^2 as the cause of the phenomena. In this case the four-dimensional space time is characterized by gravitational potential C^2. In the theory of Superunification the potential C^2 is named as an action potential [2, 3]. The action potential $\varphi_1=C^2$ is the four-dimensional gravitational potential as a function of time (t) and space (x, y, z):

$$\varphi_1 = C^2 = f(t, x, y, z) \tag{1}$$

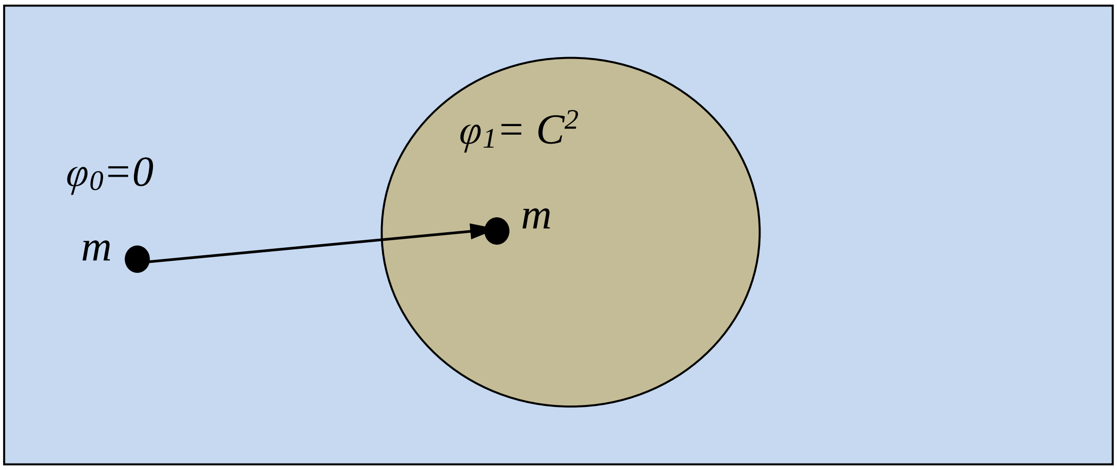

FIG. 1. The scheme of the calculation of the energy for transfer of a mass from infinity to the region of the four-dimensional space-time with the action potential φ_1=C^2.

Fig. 1 shows the process of the birth of an elementary particles and its mass from the vacuum when the particle is transported from infinity zero potential $\varphi_0=0$ to the region of the field of the four-dimensional space-time with the potential $\varphi_1=C^2$. Then the work (energy) W_1 on transfer of the mass m from infinity with $\varphi_0=0$ to the region of the field with the potential C^2 will be evaluated by integral:

$$W_1 = \int_{\varphi_0=0}^{\varphi_1=C^2} m d\varphi = mC^2 \quad (2)$$

The integral (1) is the simplest and easiest to understand derivation of the equivalence of mass and energy. If we accept that the rest mass m_0 is defined by a constant C_0^2 (C_0^2=const) the integral (1) in the absence of an external gravitational perturbation takes the following form:

$$W = \int_{\varphi_0=0}^{\varphi_1=C_0^2} m d\varphi = m_0 C_0^2 \quad (3)$$

W (3) is the energy of a spherical gravitational field which is formed around an elementary particle with mass. Fig. 2 shows a spherical gravitational well inside four-dimensional space-time which is formed as a result of mass birth of an elementary particle. This is the concept of Einstein's curved four-dimensional space-time for gravity [4].

The depth of the gravitational well in the fig. 2 can be estimated by Newton's classical gravitational potential $\varphi_n=Gm_0/r$, where G is gravitational constant, r is distance. Then the energy W_1 (3) of the spherical deformation away from the center of the gravitational well we can estimate by the definite integral:

$$W_1 = \int_{\varphi}^{\varphi_1=C_0^2} m d\varphi = m_0 C_0^2 - m_0\varphi = m_0(C_0^2 - \varphi) \quad (4)$$

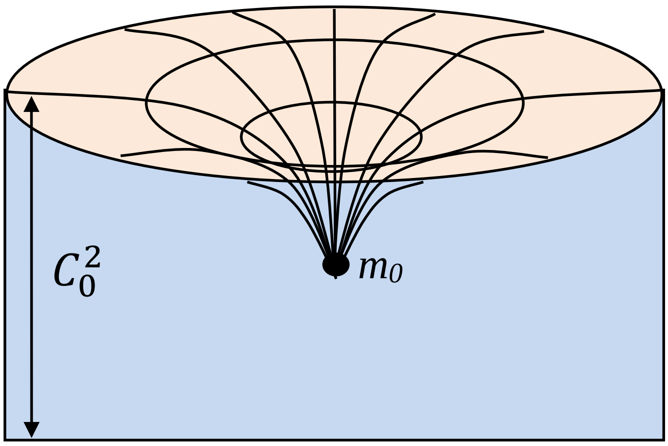

FIG. 2. The gravity's effect is a consequence of the curvature of the four-dimensional space-time as a result of his spherical deformation at the time of formation of a mass *m_0* of an elementary particle.

Gravitational potential difference $(C_0^2 - \varphi_n)$ in (4) is determined by the four-dimensional gravitational potential C^2, which indicates the depth of the four-dimensional space-time:

$$C^2 = C_0^2 - \varphi_n = C_0^2 - Gm_0/r \qquad (5)$$

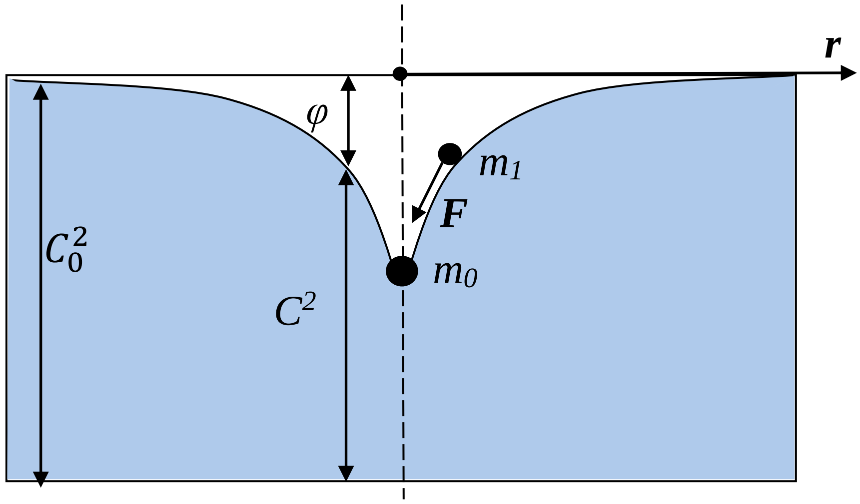

FIG. 3. Gravitational diagram shows a deformation (a curvature) of the four-dimensional space-time as a result of a birth mass m_0 of elementary particle.

Fig. 3 shows the gravitational well (Fig. 2) in the two-dimensional images with the application of the gravitational potentials: C_0^2, C^2, φ_n. The gravitational diagram is an illustration of the formation of a spherical gravitational well inside the four-dimensional space-time as a result of birth mass of an elementary particle. As it can be seen state of the curved and spherically deformed four-dimensional space-time is characterized by the gravitational action potential $\varphi_1 = C^2 = f(t, x, y, z)$ (1) (darkened region). An action potential C^2 determines depth of the four-dimensional space-time. Newton's potential φ determines depth of a gravitational well. Let's represent the potential φ as $\varphi = \Delta C^2$:

$$C^2 = C_0^2 - \Delta C^2 \qquad (6)$$

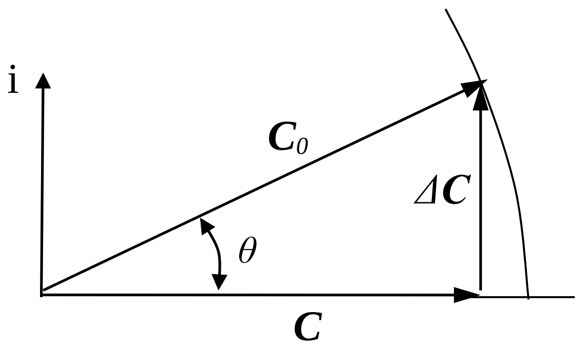

FIG. 4. The speed of a light *C* can be represented in the complex plane.

The formula (6) is the Pythagorean Theorem for the speed of light C_0, C, ΔC (Fig. 4). As it can be seen, $\boldsymbol{C_0}$, $\boldsymbol{C}$, $\Delta\boldsymbol{C}$ are vectors, and $\boldsymbol{C}\perp\Delta\boldsymbol{C}$. Therefore, the basis of the GR is the geometry.

The formula (6) can be presented as:

$$dC^2 = dC_0^2 - d(\Delta C)^2 \tag{7}$$

At that the invariant $dC^2$is analog of ds^2; $dC_0^2 \rightarrow (dx_1^2 + dx_2^2 + dx_3^2)$; $d(\Delta C)^2 \rightarrow dx_4^2$ [1]. The speed of light C in the four-dimensional space time perturbed gravitation is defined by a square root of action potential $\varphi_1 = C^2$ (5):

$$C = \sqrt{\varphi_1} = \sqrt{C_0^2 - \varphi} = C_0\sqrt{1 - \frac{\varphi}{C_0^2}} \tag{8}$$

On the complex plane (Fig. 4) the speed of light is represented by a complex number:

$$C_0 e^{i\theta} = C + i\sqrt{\varphi} \tag{9}$$

$$\theta = arcsin\frac{\sqrt{\varphi}}{C_0} \tag{10}$$

where C_0 is modulus of the speed of light C; θ is argument of a complex number; e=2.71…; $i = \sqrt{-1}$.

In the absence of the perturbing gravitational mass $\varphi = 0$, the speed of light C (8) is determined by a constant C_0. In the absence of the perturbing gravitational mass $\varphi = 0$, the speed of light C (8) is determined by a constant C_0. This corresponds to the special theory of relativity. In the presence of gravitational perturbations the speed of light C is variable (8). This corresponds to general relativity (GR).

Thus, the state of the perturbed gravity four-dimensional space-time can be described by a new invariant (5) and (6) the absolute parameters of the field, which represents a substantial addition to the geometric interpretation of the mathematical apparatus of general relativity (GR). It should be noted that the invariants (5) and (6) refer to a static gravitational field, but in the dynamics have another form [2, 3].

Let's look at some of the practical application of the formula (5):

1. Newton's law of universal gravitation. Let's write down Poisson's equation taking into account (5) for a gravitational field (where ρ – substance density):

$$\Delta(C_0^2 - \varphi) = 4\pi G\rho \tag{11}$$

Taking into account (11) we write the gravitational force $\boldsymbol{F}$ acting on the test mass m_1 inside the gravitational well (Fig. 3), where $\boldsymbol{1r}$ is a unit vector in the direction $\boldsymbol{r}$:

$$\boldsymbol{F} = -grad(C_0^2 - \varphi)m_1 = -G\frac{m_0 m_1}{r^2}\mathbf{1}_r \qquad (12)$$

As can be seen, introduction of the potentials of C^2 and C_0^2 does not change of Newton's law of universal gravitation for force gravity $\boldsymbol{F}$ (12) which is directed at the "bottom" of the gravitational well. The introduction of the gravitational potentials C^2 and C_0^2 allows to apply the principle of superposition of fields in static, when gravitational field of elementary particles be added together by presenting the total field of the body or of the cosmological object.

Therefore, the proposed method of calculation can be applied not only to calculate the gravitational field of the elementary particles, but also for cosmological objects.

2. Dark energy. If in (5) change the sign from minus to plus and enter it in (9), we obtain the parameters of four-dimensional space-time in the state of anti-gravity, which is characterized by the creation of gravitational hillock (Fig. 5). Then under the influence of force of antigravitational pushing away $\boldsymbol{F}$ (14) test mass m will be repelled from the system center, rolling down from a gravitational hillock in the direction of $\boldsymbol{r}$:

$$C^2 = C_0^2 + \varphi_n \qquad (13)$$

$$\boldsymbol{F} = -grad(C_0^2 + \varphi_n) = G\frac{m_0 m_1}{r^2}\mathbf{1}_r \qquad (14)$$

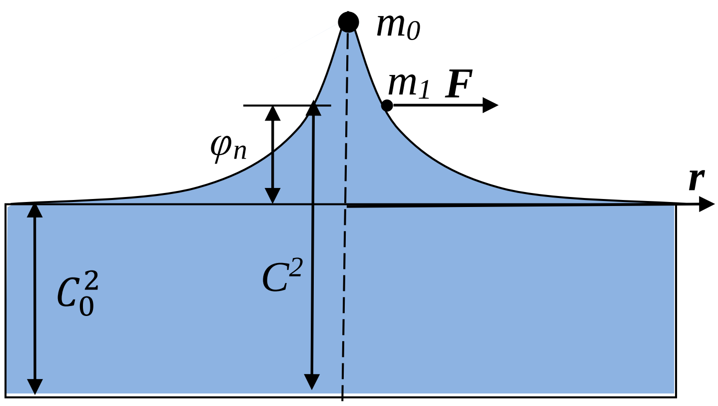

FIG. 5. The gravitational hillock inside of the four-dimensional space-time is in a state of antigravitation.

It is possible to assume that our four-dimensional Universe isn't flat and it has a curvature according to (13) (figs. 4) explaining the accelerated recession of galaxies by action of global antigravitation. Dark energy it is not nothing but a deformed state four-dimensional space-time in the volume of the Universe. In any case gravitation forces $\boldsymbol{F}$ (12) (figs. 3) and antigravitation forces $\boldsymbol{F}$ (14) (figs. 5) are directed to the region of the decrease of the gravitational action potential C^2.

3. Dark matter. Inside of the four-dimensional space-time we can observe repeatedly explosions and the birth of stars which generate gravitational waves. Interferences of the gravitational waves create areas of non-uniform space-time in lack of the perturbing gravitational masses. These areas deflect a ray of light bending its trajectory. In this case the state of the field of inhomogeneous four-dimensional space-time is taken into account variations in the gravitational potential $\pm\Delta C^2$ (fig. 6):

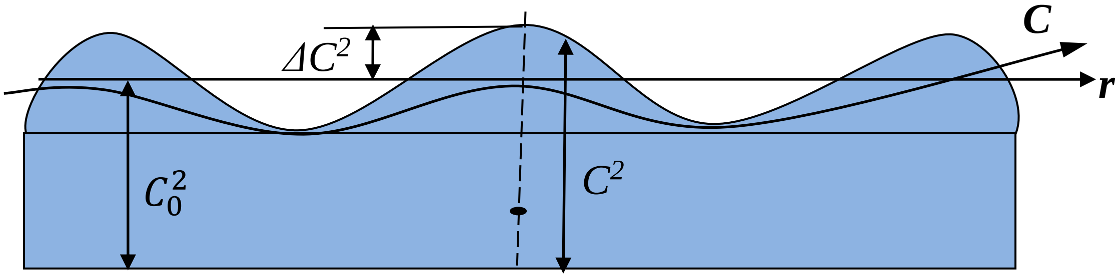

FIG. 6. The deflection of a light ray is by the inhomogeneous four-dimensional space-time.

$$C^2 = C_0^2 \pm \Delta C^2 \tag{14}$$

It's like ripples on water refracting light rays. If to take potential C_0^2 as a zero-point (level), the changes of a zero level are similar to gravitation action [5]. Dark matter is a special state of the inhomogeneous four-dimensional space-time in the absence of perturbing gravitational masses.

Thus, introduction of four-dimensional gravitational potential of C^2 (2) considerably expands possibilities of the theory of general relativity (GR), explaining from uniform positions in considered cases the nature of gravitation, antigravitation, dark energy and matter. This material is presented in a static in a general view without details. In the dynamics of the new method of calculation have more analytical capabilities. Parameters of time t (1) are included in the Poisson's equation, which describes the distribution of time in the four-dimensional space-time as chronal field [2]. I introduced in 1996 in theoretical physics four-dimensional quantum of space-time (quanton) which led to creation of the theory of Superunification that unites the theory of relativity and quantum theory [2]. In the theory of Superunification the four-dimensional space-time is considered as Einstein's Uniform field [4] in the form of quantized space-time. This unified field is the carrier of the superstrong electromagnetic interaction (SEI) - the fifth fundamental force, which was predicted by P. Davis as Superforce and which unites all known fundamental interactions from uniform positions. [6].

This article was submitted to the Physical Review Letters in March 2013, but was rejected by the reviewer without explanation and then published on my blog [7]. I took these materials from the theory of Superunification [2, 8].

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