Deformation Vector D of Quantum Density is the Basis of Quantum Gravity

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Abstract. The fact of unification the general theory of relativity (GR) and quantum theory takes place in the theory of Superunification. The Standard Model (SM) is an imperfect model of physics that is incapable of unification with gravity. Physicists have been searching for a new particle such as graviton, strings, Higgs boson and others particles to create the Superunification for many decades. But they could not do this. It was a difficult task and I solved it. I made the theory of Superunification [1, 2]. Quanton is a new four-dimensional particle of time and space which forms the basis of the theory of Superunification. The quantum density of a medium is the concentration of quantons in a unit volume of quantized space-time. The deformation (Einstein's curvature) of quantized space-time is the basis of gravity. The deformation vector **D** of the quantum density of the medium determines the magnitude and direction of gravitational forces. Gravity occurs when there is a gradient of the quantum density of the medium inside the quantized space-time. The gradient of the quantum density of the medium characterizes the strength of the gravitational field and is described by the deformation vector **D**. This concerns the creation of artificial gravity (antigravity) forces in the development of non-reactive quantum engines for space. My company has created several types of Leonov's quantum engines that have been successfully tested. The test results of quantum engines were formalized in a protocol and published in scientific journals [3, 4]. A quantum engine is more than 100 times efficient than a liquid propellant rocket engine (LRE). This is the triumph of the theory of Superunification.

Keywords: deformation vector **D,** Einstein's curvature, general theory of relativity (GR), Standard Model (SM), theory of Superunification, quantum density, gradient of the quantum density, Leonov's quantum engines.

The Poisson equation for the quantum density ρ of a medium describes gravity in the theory of Superunification [1, 2, 5]:

$$\mathrm{div}(\mathrm{grad}\rho) = k_o \rho_m \tag{1}$$

where k_0 is the proportionality coefficient,

ρ_m is the density of matter, kg/m^3.

The Poisson equation (1) has a two-component solution in the form of a system of equations for the regions of gravitational extension ρ_1 and compression ρ_2 of quantized space-time as a result of its spherical deformation during the formation of the mass of a particle (body) [1, 5, 6]:

$$\begin{cases} \rho_1 = \rho_o \left(1 - \dfrac{R_g}{r}\right) \text{ at } r \geq R_S \\ \rho_2 = \rho_o \left(1 + \dfrac{R_g}{R_S}\right) \end{cases} \tag{2}$$

where ρ_o is quantum density of undeformed quantized space-time;

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

R_g is gravitational radius (without multiplier 2):

$$R_g = \frac{Gm}{C_o^2} \tag{3}$$

where G is gravitational constant;

m is mass, kg;

C_o^2 is gravitational potential of undeformed quantized space-time, J/kg.

We use the divergence operation of the gradient of quantum density of the medium for solving (2). For this purpose, we introduce the deformation parameter **D** of the quantized space-time. Deformation **D** is a vector indicating the direction of the fastest variation of the quantum density of the medium for the deformed space-time. In this case, the deformation rector **D** is determined by the gradient of quantum density with respect to the direction. For the spherically deformed space-time, the deformation vector **D** is determined by the gradient of the quantum density of the medium with respect to radius **r** [1, 5, 6]:

$$\mathbf{D} = \text{grad}\rho_1 = \frac{\partial \rho_1}{\partial \mathbf{r}} = \rho_o \frac{\partial}{\partial \mathbf{r}}\left(1 - \frac{R_g}{r}\right) = \rho_o \frac{R_g}{r^2}\mathbf{1_r} \tag{4}$$

where $\mathbf{1}_r$ is the unit vector in the direction of radius r.

As indicated by (4), the initial field of distribution of the quantum density in the operation of the gradient changes to the vector of the field of a family of the vectors **D** directed from the deformation centre.

Further, we determine the flow $\Phi_\mathbf{D}$ of the deformation vector **D** penetrating any closed spherical surface *S* around the interface R_S (deformation centre) of the deformed quantized space-time:

$$\Phi_\mathbf{D} = \oint_S \mathbf{D}dS = \frac{\rho_o R_g}{r^2} 4\pi r^2 = 4\pi\rho_o R_g \tag{5}$$

Divergence is determined by the limit of the flow of the field originating from some volume to the value of this volume when it tends to 0. However, in this case, the volume of the spherically deformed space-time does not tend to 0 and it tends to the limiting volume V_S, determined by radius R_S. This is the volume of the elementary particle, which is very small, in comparison with the dimensions in the macroworld. Accepting that V_S is the volume close to zero volume, we write the Poisson gravitation equation for the quantum density of the medium:

$$\mathrm{div}\mathbf{D} = \frac{\lim}{V \to V_S} \frac{1}{V} \oint_S \mathbf{D} dS = 4\pi\rho_o \frac{R_g}{V_S} \tag{6}$$

Or

$$\mathrm{div}\mathbf{D} = \mathrm{div}(\mathrm{grad}\rho_1) = 4\pi\rho_o \frac{R_g}{V_S} \tag{7}$$

The Poisson vector equation (7) in the rectangular coordinate system appears in the partial derivatives of the second order with respect to the directions (x, y, z) for the quantum density of the medium ρ (in a general case):

$$\frac{\partial^2 \rho}{\partial\ x^2} + \frac{\partial^2 \rho}{\partial\ y^2} + \frac{\partial^2 \rho}{\partial\ z^2} = 4\pi\rho_o \frac{R_g}{V_S} \tag{8}$$

If we integrate the equations (8) and (7), we obtain (2) for the external and internal regions in relation to the gravitational interface. This method initially enabled us to find a solution of the equation (2) and then transfer from the solution to deriving the Poisson equation in the Cartesian coordinate system:

$$\mathrm{div}\mathbf{D} = \frac{\partial^2 \rho}{\partial\ x^2} + \frac{\partial^2 \rho}{\partial\ y^2} + \frac{\partial^2 \rho}{\partial\ z^2} \tag{9}$$

From (9) we write the deformation vector **D**:

$$\mathbf{D} = \frac{\partial \rho}{\partial x} i + \frac{\partial \rho}{\partial y} j + \frac{\partial \rho}{\partial z} k \tag{10}$$

Where **i, j, k** is unit vectors (orts).

$$|D| = \sqrt{\left(\frac{\partial \rho}{\partial x}\right)^2 + \left(\frac{\partial \rho}{\partial y}\right)^2 + \left(\frac{\partial \rho}{\partial z}\right)^2} \tag{11}$$

The direction $\mathbf{n}_D$ of the deformation vector **D** is:

$$\mathbf{n_D} = \frac{\mathbf{D}}{|D|} = \frac{\frac{\partial \rho}{\partial x} i + \frac{\partial \rho}{\partial y} j + \frac{\partial \rho}{\partial z} k}{\sqrt{\left(\frac{\partial \rho}{\partial x}\right)^2 + \left(\frac{\partial \rho}{\partial y}\right)^2 + \left(\frac{\partial \rho}{\partial z}\right)^2}} \tag{12}$$

The quantum density ρ of the medium is an analog of the gravitational potential φ [1]:

$$\rho = \varphi \frac{\rho_o}{C_o^2} = C^2 \frac{\rho_o}{C_o^2} \tag{13}$$

where C^2 is gravitational potential of the action of deformed quantized space-time.

Based on the foregoing, we write the correct Poisson equation in gravitational potentials:

$$\mathrm{divgrad}(C_o^2 - \varphi_n) = 4\pi G \rho_m \tag{14}$$

Where φ_n is Newton's gravitational potential:

$$\varphi_n = -\frac{Gm}{r} \tag{15}$$

It is also necessary to pay attention to the fact that the Poisson equation for the quantum density (1) of the medium is equivalent, as regards the format, to the Poisson equation for the gravitational potentials (14). The theory of gravity, as a partial case of the general theory of gravitation, uses only one gravitational potential, the so-called Newton potential φ_n for the elementary particle with the mass m (15). The theory of Superunification adds two gravitational potentials: C_o^2 and C^2, where C_o^2 is gravitational potential of undeformed quantized space-time; where C^2 is gravitational potential of the action of deformed quantized space-time. This greatly expands the possibilities of the theory of gravity.

Additional gravitational potentials C^2 and C_o^2 do not change the result of Newton’s law of gravity but expand the possibilities of understanding it taking into account the adjusted Poisson equation (14). In the presence of a perturbing mass M with the potential C^2 the test mass *m* is subjected to the effect of the Newton attraction force $\mathbf{F}_n$:

$$\mathbf{F}_n = m \cdot \mathrm{grad}C^2 = m \cdot \mathrm{grad}(C_o^2 - \varphi_n) = G\frac{mM}{r^2}\mathbf{1}_r \tag{16}$$

The correction of the gravitational Poisson (14) equation became possible only with the analysis of the deformation vector **D** (4) of quantized space-time. The deformation of quantized space-time can occur without gravitational mass if this space is not flat but curved. Our universe is not flat but deformed. Therefore, galaxies move with acceleration. This concerns the creation of artificial gravity (antigravity) forces in the development of non-reactive quantum engines for space. My company has created several types of Leonov's quantum engines that have been successfully tested. The test results of quantum engines were formalized in a protocol and published in scientific journals [3, 4]. A quantum engine is more than 100 times efficient than a liquid propellant rocket engine (LRE). This is the triumph of the theory of Superunification.

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