Gravitational Diagram of a Nucleon for Gravitational Potentials

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Abstract. In [1], we examined the properties of the gravitational diagram for the quantum density of a medium. The gravity diagram clearly shows us the process of deformation of quantized space-time under the influence of gravitation. Up to this point, the theory of gravity has been limited to Einstein's curvature and its geometry of four-dimensional space-time. We retained Einstein's concept of gravity of curved space-time, and instead of its curvature, we introduced a deformation vector **D** into the theory of quantum gravity [2-5]. The theory of quantum gravity does not use probabilistic methods like wave mechanics. Einstein was right when he claimed that "God does not play dice." The quantum theory of gravity uses a new parameter - the quantum density of the medium and determinism [6]. This is the concentration of quantons per unit volume. The deformation of the quantum density of the medium is the basis of quantum gravity. Such models of deformation of the quantum density of the medium are very convenient for us for the analysis of gravity and the gravitational field. These models are visual and can avoid methodological errors in the calculations of the gravitational field and its energy. However, we are not used to new gravity models using the quantum density of the medium and the deformation vector **D.** But the quantum density of the medium is an analogue of the gravitational potentials familiar to us. We propose to do an analysis of the gravitational diagram for gravitational potentials.

Keywords: gravitational diagram, quantum density, gravitational potential, deformation vector.

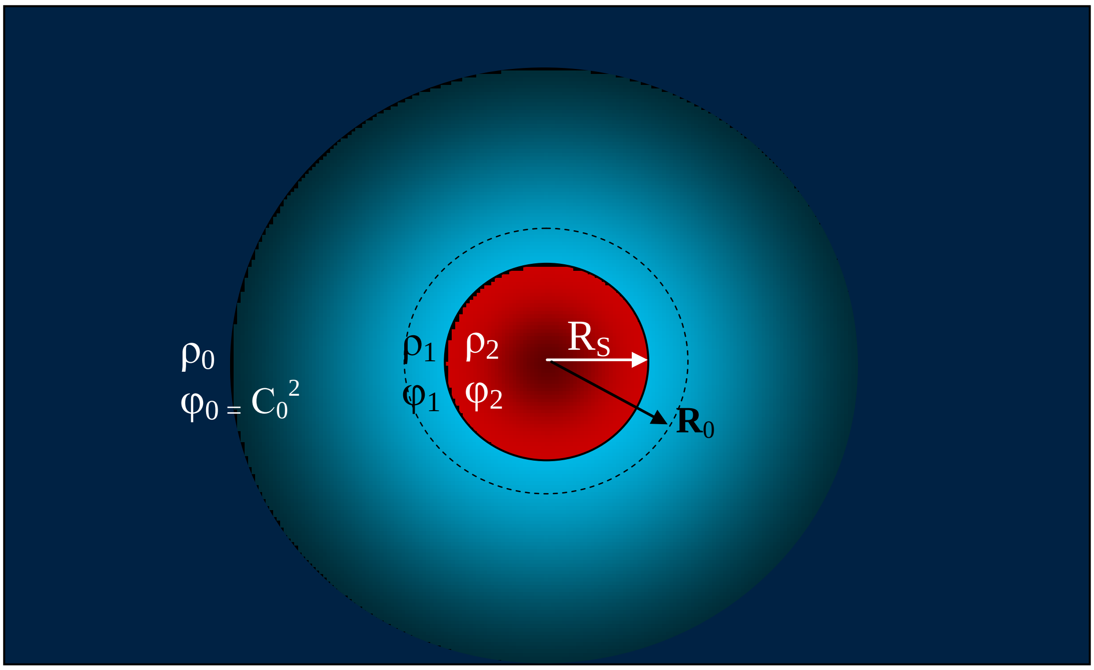

Fig. 1. Formation of the gravitation field and the nucleon mass as a result of spherical deformation of the quantized space-time by the shell of the nucleon with radius R_S. ρ_1, φ_1 – the region of expansion (blue) and ρ_2, φ_2 – the region of compression (red).

The quantum density of the medium is an analogue of the gravitational potentials. Each parameter of the quantum density (ρ_o, ρ_1, ρ_2) of the medium has its own gravitational potential ($\varphi_o = C_o^2$, φ_1, φ_2). Figure 1 shows in the section the region of quantized space-time with a spherical sign-alternating shell of the nucleon (the dotted sphere) formed inside the region. The shell is initially compressed to a sphere with radius R_S. As already mentioned, the non-perturbed quantized space-time is characterized by the quantum density of the medium ρ_0. (ρ_1, φ_1 is the region (blue) of expansion and ρ_2, φ_2 is the region (red) of compression) [1-5].

To describe the regions of spherically deformed space- time, the theory of Superunification uses four gravitational potentials: $\varphi_0 = C_o^2$, $\varphi_1 = C^2$, φ_n, φ_2 [1, 7, 8] in contrast to classic gravitation in which only one Newton gravitational potential φ_n is known [1]. The fact that the three additional gravitational potentials C_o^2, C^2 and φ_2 are unknown makes all the attempts of theoretical physics ineffective in development of the theory of gravitation. Taking into account that every value of the gravitational potential has its own quantum density of the medium, we can write the relationships between them through coefficient k_φ, denoting ρ_1' as ρ_n, i.e., corresponding to the Newton potential φ_n [1]:

$$k_\varphi = \frac{\rho_o}{C_o^2} = \frac{\rho_1}{C^2} = \frac{\rho_n}{\varphi_n} = \frac{\rho_2}{\varphi_2} = 4\cdot 10^{58}\,\frac{q}{J}\,\frac{kg}{m^3} = \text{const} \tag{1}$$

The conversion coefficient k_φ (1) of the quantum density of the medium and gravitational potentials is a constant:

$$k_\varphi = \frac{\rho_o}{C_o^2} = 4\cdot 10^{58}\,\frac{q}{J}\,\frac{kg}{m^3} = \text{const} \tag{2}$$

From (1) we find the gravitational potential we need by writing it through the quantum density of the medium and the coefficient k_φ (2):

$$\varphi_1 = C^2 = \frac{\rho_1}{k_\varphi} = C_o^2\,\frac{\rho_1}{\rho_o} \tag{3}$$

$$\varphi_2 = \frac{\rho_2}{k_\varphi} = C_o^2\,\frac{\rho_2}{\rho_o} \tag{4}$$

$$\varphi_n = \frac{\rho_n}{k_\varphi} = C_o^2\,\frac{\rho_n}{\rho_o} \tag{5}$$

$$C_o^2 = \frac{\rho_o}{k_\varphi} \tag{6}$$

And vice versa, from (3), (4), (5) we can write the quantum density of the medium through its gravitational potential:

$$\rho_1 = k_\varphi \varphi_1 = k_\varphi C^2 = \rho_o \frac{C^2}{C_o^2} \qquad (7)$$

$$\rho_2 = k_\varphi \varphi_2 = \frac{\rho_o}{C_o^2}\varphi_2 \qquad (8)$$

$$\rho_n = k_\varphi \varphi_n = \frac{\rho_o}{C_o^2}\varphi_n \qquad (9)$$

$$\rho_o = k_\varphi C_o^2 \qquad (10)$$

In the theory of Superunification, we describe the state of a nucleon inside quantized space-time using the Poisson gravitational equation for the quantum density ρ of a medium [1-4]:

$$\mathrm{div}(\mathrm{grad}\rho) = k_o \rho_m \qquad (11)$$

where k_0 is the proportionality coefficient,

ρ_m is the density of matter, kg/m^3.

The Poisson equation (11) 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) [1-6]:

$$\begin{cases} \rho_1 = \rho_o\left(1 - \dfrac{R_g}{r}\right) \ \text{at} \ r \geq R_S \\ \rho_2 = \rho_o\left(1 + \dfrac{R_g}{R_S}\right) \end{cases} \qquad (12)$$

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

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:

$$R_g = \frac{Gm}{C_o^2} \qquad (13)$$

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

m is mass, kg;

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

Why it is that physics could not detect previously the presence of the gravitational potential C_o^2 in vacuum taking into account its very large size? The point is potential C_o^2 is distributed over the entire space and we can take only relative measurements associated with the change of the gravitational potential. Direct analogy with the electrical potential, applied to a very large metallic sheet with a person placed on the surface of the sheet with a voltmeter is not capable of measuring the electrical potential of the sheet because the voltmeter measures only the potential difference [7, 8].

We write the classical Poisson equation for gravitational potentials φ:

$$\operatorname{div}(\operatorname{grad}\varphi) = 4\pi G\rho_m \tag{14}$$

None of the physicists before could find a two-component solution of the Poisson equation (14) for gravitational potentials by analogy with the solution for the quantum density of the medium (12). Now, by analogy with solution (12), taking into account (1), we can write a two-component solution of the Poisson equation (14) for gravitational potentials:

$$\begin{cases} \varphi_1 = C^2 = C_o^2\left(1 - \dfrac{R_g}{r}\right) \quad \text{при} \;\; r \geq R_S \\ \varphi_2 = C_o^2\left(1 + \dfrac{R_g}{R_S}\right) \end{cases} \tag{15}$$

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

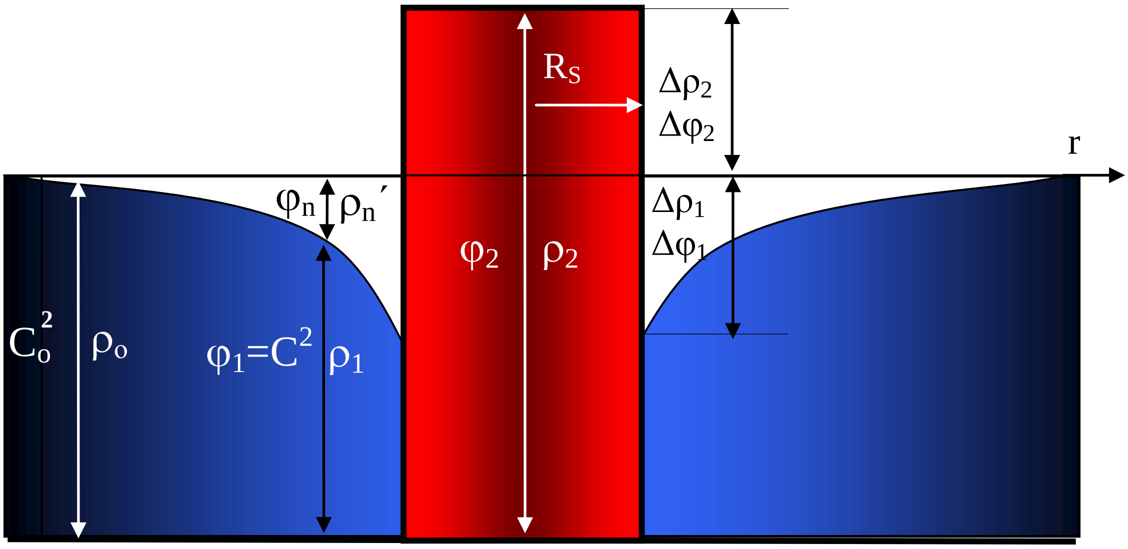

Fig. 2. Gravitational diagram of the distribution of the quantum density of the medium (ρ_1, ρ_2) and gravitational potentials (φ_1, φ_2) of the nucleon; ρ_2 is the region of compression of the medium, ρ_1 is the region of stretching of the medium.

Potential φ_1 is determined for the external region outside the interface of the medium R_S. Potential φ_2 is determined for the region inside the spherical interface R_S. In further calculations, potential φ_1 is being written as C^2. This is highly suitable because the quadratic root of φ_1 determines the speed of light in the quantized space-time perturbed by gravitation [7, 8].

Figure 2 shows the gravitational diagram of the distribution of the quantum density of the medium (12) and gravitation potentials (15) as the two-dimensional representation of the spherically deformed Lobachevski space (Fig. 1). A special feature of the gravitational diagram of the nucleon is the presence of gravitation well in the external region of the quantized medium outside the interface with radius R_S, and the interface is characterized by a jump of the quantum density of the medium and the gravitation potential. On the gravitational diagram we can clearly see the 'curvature' of the quantized space-time which cannot be seen on the spheres of the Lobachevski space (Fig. 1) in the three-dimensional representation. For spherical deformation, the curvature of space is inversely proportional to distance r to the centre of the nucleon and depends only size of the perturbing mass m, i.e., depends on the extent of deformation of the quantized space-time.

The gravitational diagram in Fig. 2 shows clearly the area of the Newton potential φ_n as the apparent potential (which does not exist in reality), included in the balance of the gravitational potentials:

$$C^2 = C_o^2 - \varphi_n \tag{16}$$

$$\varphi_n = -\frac{Gm}{r} \tag{17}$$

In reality, there is only the gravitational potential C_o^2, referred to as the action potential. From solution of (15) we can write the function of distribution of the effect potential C^2 in the external region from the interface R_S:

$$C^2 = C_o^2 - C_o^2 \frac{R_g}{r} \tag{18}$$

It may be seen that the equations (16) and (18) are completely identical, and by combined solution of these integrals we determine the value of Newton potential φ_n through potential C_o^2**:**

$$\varphi_n = C_o^2 \frac{R_g}{r} \tag{19}$$

The Newton potential φ_n from (3.48) is substituted into (19):

$$\frac{Gm}{r} = C_o^2 \frac{R_g}{r} \tag{20}$$

From (20) we determine the value parameter R_g:

$$R_g = \frac{Gm}{C_o^2} \tag{21}$$

Equation (21) determines the value of the gravitational radius R_g in the theory of Superunification which differs from the Schwarzschild radius by the absence of the multiplier 2 [1]. Immediately, attention should be given to the fact that the gravitational radius R_g (21) is not suitable for elementary particles because the elementary particle is not capable of gravitational collapse. The gravitational radius R_g in the theory of gravitation of elementary particles is a purely calculation hypothetical parameter. In the general theory (GT), the gravitational radius is a completely realistic parameter, characterizing the limiting gravitational compression (collapse) of the matter of the object into a black hole.

Substituting the value of the gravitation radius R_g (21) into (11), we transform the Poisson equation to the classic form:

$$\frac{C_o^2}{\rho_o}\mathrm{divgrad}(\rho_1) = 4\pi G\rho_m \tag{22}$$

Taking into account the fundamental nature of the principle of superposition of the fields, the equations derived previously for the gravitational field of the nucleon are valid for describing the gravitational fields of any spherical solids, including cosmological objects. In this case, every elementary particles included in the composition of the solid, concentrates inside itself a compression region by means of extension of the external region. Consequently, the surface of the solid may be regarded as the gravitational interface with the radius R_S within which the mean value of the quantum density and potential are determined by the parameters ρ_2 (12) and φ_2 (15). On the external side in relation to the gravitational interface, the gravitational field of the solid is described by the quantum density of the medium ρ_1 (12) and the gravitational action potential C^2 (15). If the solid is compressed into a black hole (microhole), radius R_S decreases to the gravitational radius R_g (21) [3, 4].

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