Two-Component Solution of the Poisson Gravitational Equation for the Quantum Density of a Medium

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Abstract. The theory of Superunification is a quantum theory of gravity or a theory of quantum gravity [1]. The theory of Superunification combines the general relativity (GR) and quantum theory. The theory of Superunification is a new quantum theory. Its basis is a new four-dimensional particle quanton - a quantum of space-time. The development of quantum theory is unthinkable without a quanton. The old quantum theory was limited by probabilistic parameters. Einstein was right when he claimed that "God does not play dice". The theory of Superunification as a new quantum theory is the theory of determinism which makes the description of complex quantum phenomena simple and understandable by classical methods. This is a new methodology in quantum theory. Two-Component Solution of the Poisson Gravitational Equation for the Quantum Density of a Medium there is an example of this new methodology. Einstein showed us that the basis of gravity is the curvature of four-dimensional space-time. But if we have a space curvature then this curvature should be compensated by its compression. Otherwise, we will have an unstable system capable of gravitational collapse. But four-dimensional space-time as a quantized medium is a stable system. And this stability of space-time gives us a two-component solution of the Poisson gravitational equation for the quantum density of the medium. So at the birth of the mass of an elementary particle inside quantized space-time, its spherical deformation occurs. We observe a compression of the quantum density of the medium inside the particle due to its extension from the outside. Thus was born the mass of an elementary particle. The two-component solution of the Poisson equation for the first time describes the process the birth of the mass of an elementary particle inside quantized space-time at the quantum level [1].

Keyword: theory of Superunification, quantum gravity, Poisson equation, two-component solution of, quantum density, quantized space-time, spherical deformation.

The quantum theory of gravitation is based on the concept of distortion of space-time proposed by Einstein which in the realities of the quantized medium transfers to deformation of the medium. In this case, it should be mentioned that gravitation starts with the elementary particles, more accurately, with the formation of mass at the elementary particles. Any elementary particle, including particles with mass, – the source of the gravitational field – is an open quantum mechanics system being an integral part of the quantized space-time.

There are no closed quantum mechanics systems in nature. They were invented by people because of the restricted, at that time, knowledge of the nature of things. This is the only method of understanding the phenomena in nature when investigating the observed objects and items. It appears that a flying stone is an object separated by its natural dimensions in itself, and is not linked with, for example, the Earth. However, the stone will fall on the Earth, like Newton's apple. It appears that the thrown stone is in fact not isolated from the Earth and is within the region of the Earth gravitational field from which it is very difficult to escape. However, we cannot see the gravitational field, and the falling stone appears to us as an independent closed system, a thing in itself.

If we could see the gravitational field, we would see an astonishing image. The gravitational field would be in the form of an aura surrounding the flying stone. This aura is determined by the formation of the quantized space-time around the stone. The Earth is surrounded by the same gravitation aura. We would see how the Earth aura absorbs the stone, whilst on the Earth surface the auras do not manage, ensuring the constant effect of gravity. However, this is only the external side. As mentioned, gravitation starts at the elementary particles including the composition of all solids, and the total gravitational field of the solid forms because of the effect of the principle of superposition of the fields. All the elementary particles and, correspondingly, all the solids, are open quantum mechanics systems.

The transition to the open quantum mechanics systems in the physics of elementary particles and the atomic nucleus enables us to investigate the problems of quantum mechanics already from the viewpoint of the unification of electromagnetism and gravitation. We can understand the structure of elementary particles which in fact are not so elementary and their composition includes a huge number of quantons, determining their quantized state, because of which the energy and mass of the particle may increase with the increase of the speed of the particle. The transition to the open quantum mechanics systems has become possible only on returning to the scientific concept of the absolutely quantized space-time. Consequently, it has been possible to determine the structure of the main elementary particles, electron, positron, proton, neutron, neutrino, photon, and also find the reasons for the formation of mass at the elementary particles [1].

In order to link the structure of the elementary particles and their mass with the deformation properties of the quantized space-time, we examine the process of formation of mass in the nucleons. For this purpose, it would be necessary to determine the shell structure of the nucleon, with the shell being capable of compressing the quantized space-time, forming the nucleon mass. This is possible if the nucleon shell is a spherical network, with the nodes of the network carrying the monopole electrical charges with alternating polarity, forming an alternating shell. In this case, regardless of the presence of the non-compensated charge in the proton shell, nucleons can be pulled together by alternating charges of the shells. These attraction forces are of the purely electrical nature, acting over a short period of time, but their parameters completely correspond to nuclear forces. The electrical nature of the nuclear forces fully fits the concept of the unified field on the path to Superunification of interactions [1, 2].

Attempts to solve the problems of this type were made a long time ago within the framework of the so-called quantum chromodynamics (QCD) based initially on three quarks, and now the number of parameters in the QCD has exceeded 100, increasing the number of problems which must be solved [33]. In addition to describing the action of nuclear forces and substantiating the charge of the adrons, and they include nucleons, it is important to solve the problem of formation of the nucleon mass which cannot be solved by the QCD. This is a dead theory which has been partially resuscitated in the theory of Superunification, if quarks are treated as whole electrical and magnetic charges and the interaction of whole quarks is transferred to quantons and the shell of the nucleons as an independent 'seed' charge of the electron (positron) [1]. In this case, we can describe the structure and state of any elementary particle, not only of the quantons, but also of leptons which include the electron and the photon. It appears that four quarks (two electrical and two magnetic charges) are sufficient for describing not only elementary particles, both open and still unopen, but also all fundamental interactions.

The attempts to explain the presence of mass at elementary particles and introduction into the quantum theory of exchange particles, the so-called Higgs particles, which provide mass for other particles, have proved to be unfounded, regardless of the application of the most advanced mathematical apparatus. According to theoretical prediction, the Higgs particles should be detected in experiments in the giant accelerator (supercollider) at CERN in Geneva. The theory of Superunification have already saved billions of dollars to the world scientific community, describing the structure of elementary particles and the nature of the gravitational field and mass [1].

Also, quarks have not been detected in experiments, not even indirectly in the form of quark-gluon plasma which should be detected when the proton reaches very high energies of the order of 200 GeV/nucleon. QCD predicted that in this case the proton should 'melt', generating quark-gluon plasma. Recently, it has been reported that some plasma had been produced at high speeds and energies and it is linked with the quark-gluon plasma. However, I really doubt the very concept of the quark-gluon plasma which can be represented by the electron-positron plasma in breakdown of the alternating shell of the nucleon, if this can take place [1]. On the other hand, analysis of the Usherenko effect with superdeep penetration of particles of the micron size into steel targets with the generation of colossal energy 102–104 times greater than the kinetic energy of the particles indicates that the electron-positron plasma in the gas is detected in experiments, and the results may form the basis of ball lightning [1].

We now transfer to the subject of this section, i.e., the physics of open quantum mechanics systems. Here it is necessary to understand how elementary particles form in the quantized space-time. The two-rotor structure of the photon was already shown in [1] as a specific particle-wave in the luminiferous medium, as some quantum bunch of the energy of electromagnetic polarisation of the quantized space-time. The suggestion that the photon can exist only at the speed of light confirms its exclusively wave nature in the luminiferous medium. The photon is an open system which is a part of the luminiferous medium without which the photon cannot form and be transferred. The open quantum mechanics systems include all known elementary particles which differ from the photon by the fact that the photon is the only particle which does not include electrical charges of the monopole type separated from the quantum and only represents the wave excited state of the quantons through which they are transferred as a single wave (soliton) [1].

All the remaining elementary particles include electrical charges-quarks in their composition. Naturally, it is not possible to describe the entire spectrum of the elementary particles. Therefore, in this book analysis is restricted to investigations of the formation of mass at the nucleons (protons and neutrons) which represent a suitable example of an open quantum mechanics system. The presence of an alternating shell in the nucleon enables us to define a distinctive gravitational boundary capable of spherical compression and stretching, forming the gravitational field of the nucleon. Consequently, the theory of gravitation and nucleons can be applied to all spherical solids, including cosmological objects, for which the surface has the form of a conventional gravitational boundary in the medium characterised by the mean statistical parameters of the medium. For non-spherical solids, only the near field is distorted, and the far field transfers to a spherical one, governed by the principle of superposition of the fields, in which the sum of spherical gravitational fields of all elementary particles, including the composition of the solid, determines its gravitational field. In the electron and the positron there is no distinctive gravitational boundary and they are placed in a separate class of the particles with a central seed charge which forms a more complicated gravitational field [1].

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 [1, 3]:

$$\rho_o = \frac{k_3}{L_{qo}^3} = 3.55 \cdot 10^{75} \frac{q}{m^3} \qquad (1)$$

where $k_3 = 1.44$ is the coefficient of filling of vacuum with spherical quantons;

L_{q0} is diameter of the quanton [1, 4]:

$$L_{qo} = 0.74 \cdot 10^{-25} \text{m} \qquad (2)$$

Evidently, in compression of the shell of the nucleon together with the medium, the quantum density ρ_2 in the middle of the shell increases above ρ_0 as a result of stretching of the external region whose quantum density ρ_1 decreases. This is the process of spherical deformation of the quantized space-time as a result of which the mass and gravitational field appears at the nucleon. The shell of the nucleon has the function of a gravitational boundary, separating the medium with different quantum densities ρ_1 and ρ_2 inside the nucleon and outside its shell.

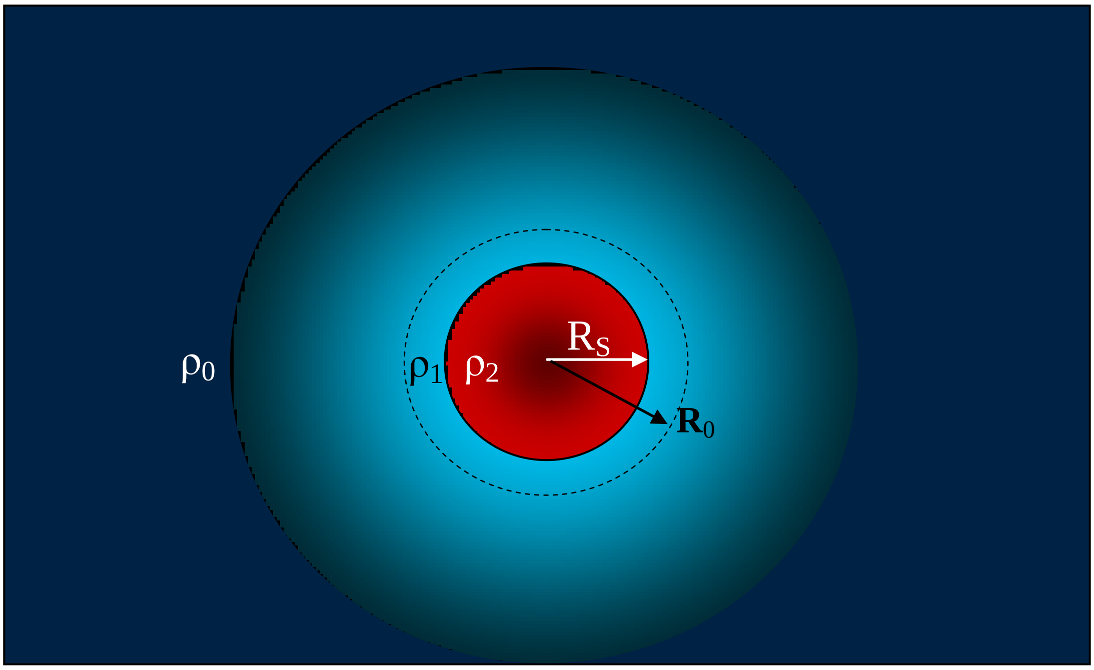

Fig. 1. Formation of the gravitation field and the nucleon mass as a result of spherical deformation of the quantized space-time by the shell of the nucleon with radius R_S. ρ_1 – the region of expansion (blue) and ρ_2 – the region of compression (red).

The sign-alternating shell of the nucleon has noteworthy properties. It can pass through the stationary quantized space-time like fishing net immersed in water. In movement, the alternating shell of the nucleon retains the spherical deformation of the quantized space-time ensuring the wave transfer of the mass of the nucleon and the corpuscular transfer of the alternating shell. In experiments, this is confirmed by the results which show that the nucleons are governed by the principle of the corpuscular-wave dualism and represent a particle-wave as an open quantum mechanics system.

In the model shown in Fig. 1, the space topologically changes when this topology differs from the topology of the non-deformed space. The geometry of such space-time can be represented by a population of Lobachevski spheres with different curvature, threaded onto each another, forming the topology of the Lobachevski spherical space. Taking into account that the dimensions of the quanton are of the order of 10^{-25} m (2), and the radius R_S on the nucleon is approximately 10^{-15} m, then in relation to the fundamental length of 10^{-25} m of the given space, the radius of the Lobachevski spheres is a very high value. This corresponds to the postulates of the Lobachevski theory and for mathematicians the given region of investigations is a gold vein because it has specific practical applications.

The model, shown in Fig. 1, can be calculated quite easily mathematically because it is determined by the properties of a homogeneous quantized medium whose plastic state is described by the Poisson equation [1]. It should be mentioned that there is still no Poisson gravitation equation. In the general theory of relativity, the classic Poisson equation is replaced by the more complicated Einstein tensor equation whose solution has not helped physicists to understand the reasons for gravitation.

Any ‘distortion’ of the quantized space-time is linked with two types of deformation: compression and extension, accompanying each other in elastic media. Compression deformation is balanced by tension deformation. In the absence of the second component which resists deformation in the elastic quantized medium, the space should be unstable and any gravitation should result in the collapse of the mass of matter into a black hole or microhole. However, the instability of quantized space-time has not been observed in experiments. Quantized space-time shows the properties of a highly stable and durable medium indicating the presence in space of the elastic properties capable of resisting any deformation.

In particular, the model of spherical deformation of the quantized space-time shown in Fig. 1 demonstrates clearly that compression deformation of the nucleon shell to radius R_S inside the shell is balanced by the tensile deformation of the quantized space-time on its external side. This model makes it possible to obtain for the first time the correct equations of state of the nucleon as a result of the spherical deformation of quantized space-time.

The solution of the problem is reduced to the determination of the distribution function of the quantum density of the medium in space: ρ_1 – on the external side of the gravitational boundary with radius R_S and ρ_2 – inside the nucleon boundary. Inside the region R_S this problem is solved by an elementary procedure. The number of quantons N_{q0} inside the region R_0 with volume V_0 prior to compression and after compression N_{q2} in R_S remain constant and is determined by quantum density ρ_0:

$$N_{qo} = N_{q2} = \rho_o V_o = \frac{4}{3}\pi R_o^3 \rho_o \tag{3}$$

In compression, the internal volume V_0 decreases to V_S and the quantum density ρ_2 correspondingly increases:

$$\rho_2 = \frac{N_{qo}}{V_S} = \rho_o \frac{V_o}{V_S} = \rho_o \left(\frac{R_o}{R_S} \right)^3 \tag{4}$$

Equation (4) determines quantum density ρ_2 inside region R_S as a value which does not depend on the distance r inside the compressed region.

A difficult mathematical problem is the determination of the distribution function of quantum density ρ_1 in the external region from the interface R_S in relation to the distance r. The attempts for direct derivation of the differential equation on the basis of the redistribution of quantum density and its unification do not give positive results. The resultant equations were diverging and solutions infinite. This can be explained from the physical viewpoint. In compression of the internal region R_S the released volume is filled from the external side with quantons which are pulled to the interface from the external field from the surrounding quantized space-time. Since the spatial field is continuous, the movement of the quantons at the interface from the external field spreads to infinity, leading to diverging equations. When these problems are encountered in theoretical physics, it is necessary to find other approaches to solving them because the currently available mathematical apparatus is not suitable for solving the infinity problem.

In this case, the formulated task is solved by purely algebraic methods because the given scalar field is characterized by the absolute parameters (ρ_0, ρ_1, ρ_2) and it is not necessary to work with the increments of these parameters. To solve the given task, it is necessary to analyze another state of the given field when the continuous compression of the region R_S reaches the finite limit, with restriction by gravitational radius R_g (without multiplier 2), and further compression of the field is not possible:

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

where G is gravitational constant; m is mass, kg; C_o^2 is maximum gravitational potential of quantized space-time, J/kg.

This state may determine the state of the black microhole, characterizing the nucleon by gravitational radius R_g (5) which is a purely calculation parameter, representing the hypothetical interface at which the quantum density of the medium ρ_1 on the external side decreases to ρ_0, i.e. $\rho_1 \to 0$ at $R_S \to R_g$. As a result, the functional dependence $\rho_1(r)$ with the increase of the distance from the nucleon by the distance r has the form of a single curve for the specific radius R_g, ensuring the balance of the quantum density of the medium:

$$\rho_o = \rho_1 + \rho_1' \tag{6}$$

Equation (6) includes ρ_1' as an apparent quantity, characterizing the deficit of quantum density ρ_1 in relation to the non-deformed space-time with quantum density ρ_0:

$$\rho_1' = \rho_o - \rho_1 \tag{7}$$

The functional dependence ρ_1' determines the curvature of the distorted space-time and has the form of a typical inverse dependence which should be determined by finding the degree n of the curvature of the field $1/r^n$. Whilst the exponent n is unknown, is this an integer 1, 2, etc, or a fraction? From the mathematical viewpoint it is incorrect. From the viewpoint of physics this approach is justified because we define the curvature of the scalar field and verify whether the given temperature corresponds to or differs from the experimental data. It is more rational to replace curvature $1/r^n$ by its equivalent R_g/r^n connected with R_g (5). The dependence ρ_1' is a function of distance r for R_g/r^n:

$$\rho_1' = \rho_o \frac{R_g}{r^n} \qquad (8)$$

From the balance (6) taking (8) into account, we obtain:

$$\rho_1 = \rho_o - \rho_1' = \rho_o - \rho_o \frac{R_g}{r^n} = \rho_o \left(1 - \frac{R_g}{r^n}\right) \qquad (9)$$

In the limiting case at $r = R_g$, the function (3.34) is equal to 0:

$$\rho_1 = \rho_o \left(1 - \frac{R_g}{R_g^n}\right) = 0 \qquad (10)$$

The condition (10) is fulfilled unambiguously at the equality:

$$\frac{R_g}{R_g^n} = 1 \qquad (11)$$

Equality (11) holds at n = 1, which requires confirmation. This is possible only if the shell of the nucleon inside the quantized space-time remains spherical in any situation, determining the principle of spherical invariance [1].

Thus, the required distribution of the quantum density ρ_1 (r) at any distance r is determined by the exponent of the first-degree n = 1 from distance r:

$$\rho_1 = \rho_o \left(1 - \frac{R_g}{r}\right) \quad \text{при} \quad r \le R_S \qquad (12)$$

Equation (12) includes the relative dimensional curvature k_R of space-time which is highly suitable in analysis of its deformation:

$$k_R = \frac{R_g}{r} \le 1 \qquad (13)$$

In the limiting case at r = R_g, the relative curvature of the field has the maximum value equal to 1. In all other cases, the curvature of the field increases with the increase of the distance from the region R_g and is always smaller than unity.

If we compare the equations (12) and (2) of the distribution of quantum density ρ_1 and ρ_2, it is necessary to reduce the parameters of the field in (2) to the same form (12), expressing ρ_2 by the relative curvature of the field k_R (13). For this purpose, we determine the ‘jumps’ $\Delta\rho_1$ and $\Delta\rho_2$ of quantum density of the medium at the interface R_S in relation to ρ_0 on the external $\Delta\rho_1$ and internal $\Delta\rho_2$ sides, respectively. Evidently, because of the symmetry of the field at the interface, the increase of the quantum density $\Delta\rho_2$ inside, possibly by means of the same decrease of the quantum density $\Delta\rho_1$ on the external side, we can ensure the balance of the quantum density at the interface:

$$\Delta\rho_1 = \Delta\rho_2 \qquad (14)$$

The jump of the quantum density of the medium $\Delta\rho_1$ on the external side is determined from equation (12) on the condition that r = R_S:

$$\Delta\rho_1 = \rho_o - \rho_1 = \rho_o \frac{R_g}{R_S} \qquad (15)$$

Taking equations (15) and (14) into account, we determine the value of the quantum density of the medium ρ_2 inside the nucleon:

$$\rho_2 = \rho_o + \Delta\rho_1 = \rho_o \left(1 + \frac{R_g}{R_S}\right) \qquad (16)$$

As a result of transformations, quantum densities ρ_1 (12) and ρ_2 (16) of the spherically deformed quantized space-time have been reduced to the same form and have the form of the system:

$$\begin{cases} \rho_1 = \rho_o \left(1 - \dfrac{R_g}{r}\right) \text{ at } r \geq R_S \\ \rho_2 = \rho_o \left(1 + \dfrac{R_g}{R_S}\right) \end{cases} \qquad (17)$$

The distribution of the quantum density of the medium (17) was determined for the two components ρ_1 and ρ_2 which balance each other, forming a stable system. The system (17) is the correct solution of the Poisson for the quantum density ρ of a medium:

$$\operatorname{div}(\operatorname{grad}\rho) = k_o \rho_m \qquad (18)$$

where k_0 is the proportionality coefficient,

ρ_m is the density of matter, kg/m^3.

The solution (17) of the gravitational Poisson (18) equation is obtained for a spherically deformed space-time based on the effectively selected physical model of the nucleon inside the quantized space-time.

It should be mentioned that the solution of the tasks described previously cannot be carried out by purely mathematical methods without knowing the physical model of gravitation which is based on the straight mathematical conditions defined by nature. The quantum density ρ_0, ρ_1, ρ_2 (17) of the medium is equivalent to gravitational potentials, respectively [1]. But this is another topic in the theory of Superunification.

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