The Calculated Diameter of the Space-Time Quantum (Quanton)

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The diameter of the quantum of space-time (quanton) cannot be found experimentally, given that the diameter of the quanton 10^{-25} m is ten orders of magnitude smaller than the classical radius 10^{-15} m of the electron. The region of such small sizes 10^{-25} m belongs to the region of the ultra microworld. We do not have devices that could look inside the quantized space-time. We can penetrate into the region of the ultra microworld of quantons only by the power of our mind using mathematical calculations. To perform this work requires an ingenious theoretical physicst. Prior to this, no one has managed to penetrate the power of the mind into the interior of quantized space-time in the region of the ultra microworld of quantons 10^{-25} m. The diameter of a quanton 10^{-25} m is a new fundamental length — Leonov's length. It establishes the discreteness of quantized space-time, and it is 10 orders of magnitude greater than the Planck length of 10^{-35} m.

Keywords: quantum of space-time, quanton, quantized space-time, fundamental length, Leonov's length, Planck length.

Up to now, in studying the properties of the vacuum field, the dimensions of the space quantum (quanton) were assumed to be of the order of 10^{-25} m, which are ten orders of magnitude smaller than the classic radius of the electron. Naturally, experimental measurements of the dimensions of such a small magnitude are not yet possible because of the fact that no methods and devices are available. It is at present difficult to predict the construction of supersensitive measuring equipment in the range of measurement of the linear dimensions in the microworld on the level of the dimensions of 10^{-25} m. If this becomes possible, it will be based on the new principles, resulting from the Superunification theory.

Evidently, a promising direction in the area of investigation of the small dimensions of the order of 10^{-25} m is the application of torsional fields in the quantised space-time. If it is possible to produce oscillations of this type in vacuum, then in focusing of radiation it may be possible to reach the level of interaction of the dimensions of the quanton. The possibilities of electron microscopy are limited by the size of the electron. New methods of quantum microscopy will be limited by the dimension of the quanton but, in any case, the resulting power of quantum microscopy with respect to linear dimensions will be tens of orders of magnitude greater than the power of electron microscopy.

At the moment, we determine the dimensions of the quanton by analytical calculations in the Superunification theory. For this purpose, it is necessary to perturb the quantized space-time and analyze the response reaction to the external perturbation. In particular, the capacity of the quantized space-time for spherical deformation enables us to derive equations linking together the parameters of deformation of the quantized space-time and the energy of the elementary particle. On the other hand, deformation of the quantized space-time is determined by the energy of a great number of quantons in its deformed local region. Linking the parameters of the perturbing particle with the parameters of the quanton in the deformed region of space, we can determine the calculation dimensions of the quantons.

Therefore, the particle perturbing the vacuum field is represented by the electrically neutral neutron with a shell structure with a distinctive gravitational interface (chapter 5 [1, 2, 3]). The gravitational diagram of the neutron is shown in Fig. 1. The diagram makes it possible to analyze the processes of spherical deformation of the quantized space-time on the plane, determining the distribution of the quantum density of the medium (or gravitational potentials) on the basis of the solution of the Poisson equation for the gravitational field of the particle. Read more [3, 4].

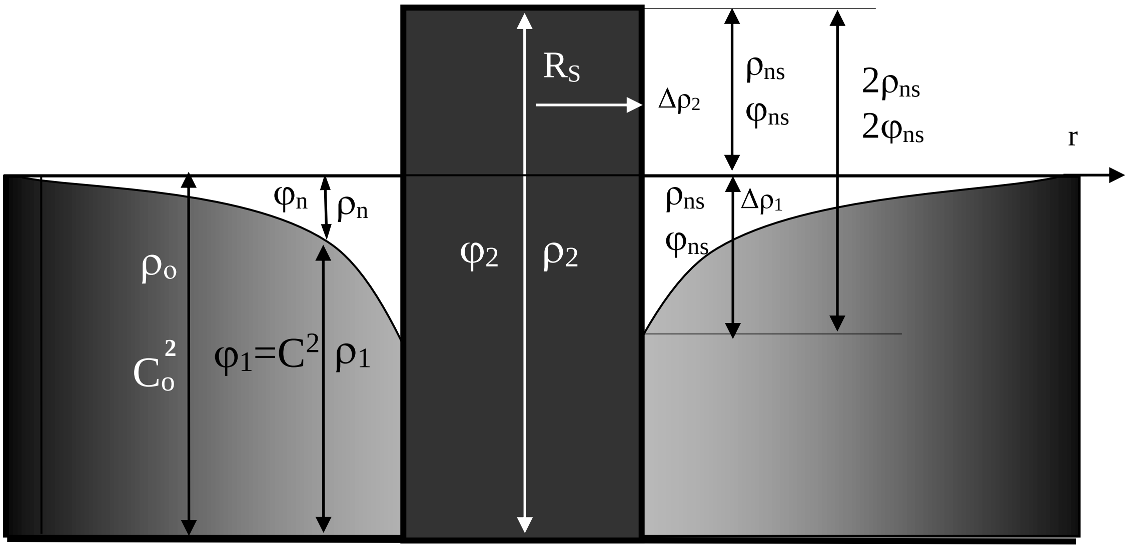

Fig. 1. The gravitational diagram of the proton and the distribution of the quantum density of the medium (ρ_1, ρ_2) and the gravitational potentials (φ_1, φ_2) of the proton. ρ_2 is the region of compression of the medium, ρ_1 is the region of tension of the medium.

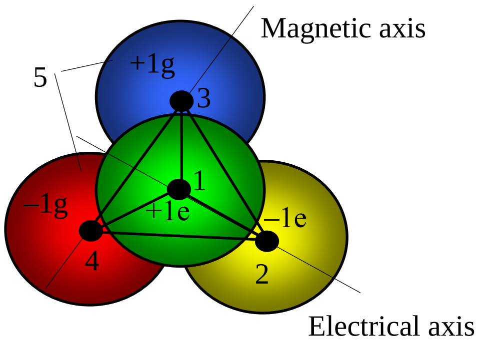

Fig. 2. The electromagnetic quadrupole (top view).

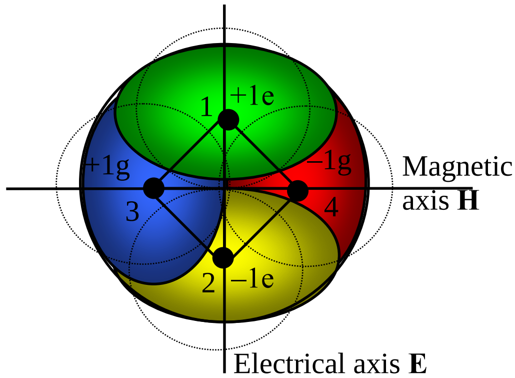

Fig. 3. The quanton in projection (rotated in space).

The electromagnetic quadrupole, shown in Fig. 2, has not as yet formed as the space-time quantum. It is evident that under the effect of the colossal forces of mutual attraction between the monopole charges, the electromagnetic quadrupole must be compressed into a spherical particle forming a quanton as the space-time quantum (Fig. 3). The quanton is protected against collapse by the properties of the monopoles: their finite dimensions and elasticity. In particular, the electricity and magnetism inside the quanton are connected by the superstrong electromagnetic interaction (SEI), merging into a single substance. The arrangement of the centers of the monopole charges at the tips of the tetrahedron inside the quanton forms a superelastic and stable structure.

The quanton consists of four integers quarks: two magnetic quarks (+1g and –1g) and two electrical quarks (+1e and –1e) is connected by the relationship:

$$g = C_0 e = 4.8 \cdot 10^{-11} \text{Am} \ \ (\text{L or Leon}) \ \neq \text{~~Dr~~} \qquad (1)$$

where $C_0 = 3 \cdot 10^8$ m/s is the speed of light in the quantized space-time, not perturbed by gravitation;
$e = 1.6 \cdot 10^{-19}$ C is the elementary electrical charge.

(Leonov's comments 2019. **Unit magnetic charge – Leon [L].** Unit electric charge – Coulomb [C]. My early unit of measurement of magnetic charge in Dirac [Dr] is abolished and henceforth the dimension of the magnetic charge is measured in Leon. Read my article: "**Unit of measurement of magnetic charge – Leon.**").

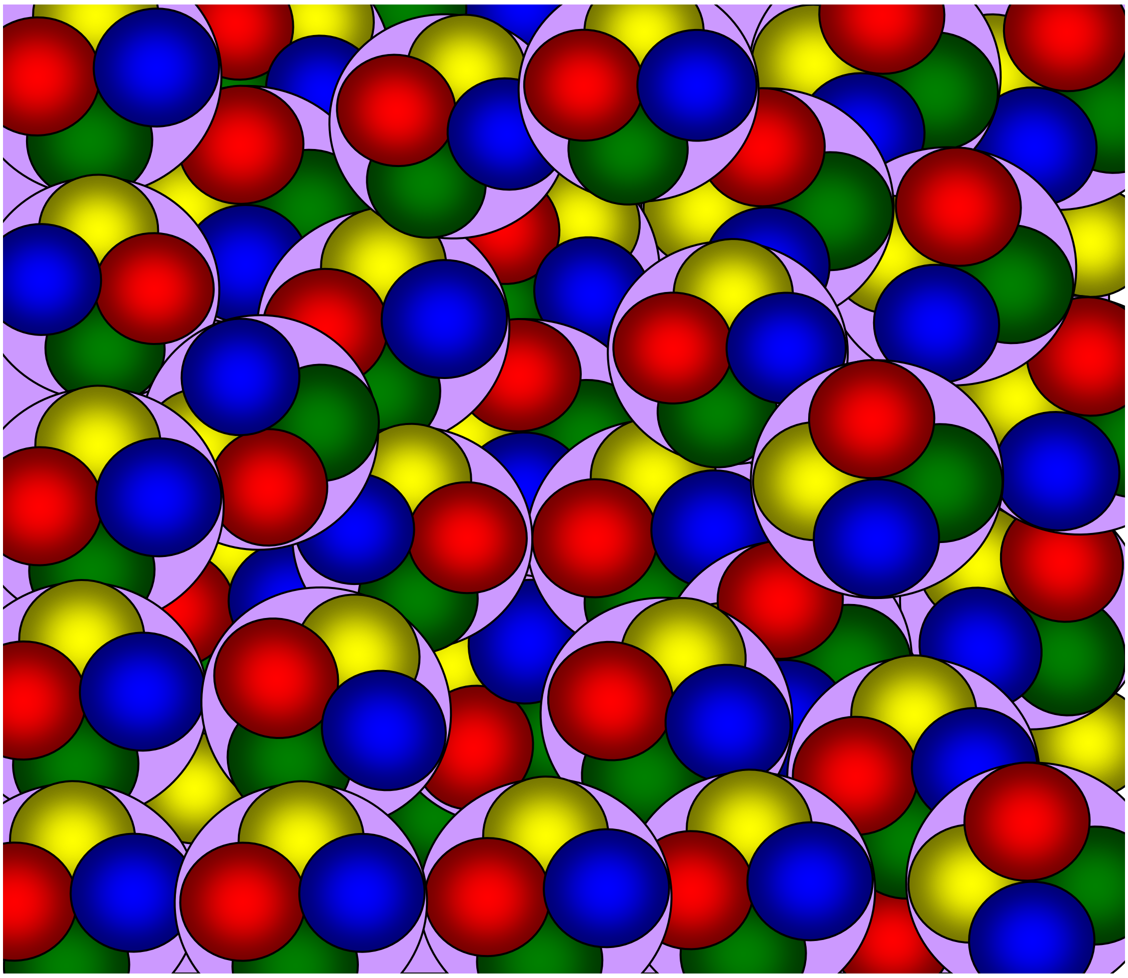

Fig. 4. Schematic representation of the structure of quantized space-time as a result of electromagnetic quantization.

The method of calculating the dimensions of the quanton is based on the distinctive relationship of the diameter L_{q0} of the quantum (Fig. 3) with the quantum density of the medium ρ_0 of the non-perturbed quantized space-time (Fig.4):

$$\rho_o = \frac{k_3}{L_{qo}^3} = \frac{1{,}44}{L_{qo}^3} \frac{\text{quantons}}{m^3} \qquad (2)$$

The filling coefficient k_3 = 1.44 takes into account the increase of the density of filling of the volume with the spherical particles represented by the shape of the quanton. The value of the filling coefficient is determined by analytical calculations.

From equation (2) we determine the quanton diameter:

$$L_{qo} = \sqrt[3]{\frac{k_3}{\rho_o}} \qquad (3)$$

Thus, in order to determine the dimension of the quanton (3), it is necessary to know the quantum density ρ_0 of the medium of the non-perturbed vacuum field. It is not possible to measure directly or determine the quantum density of the non-perturbed quantized space-time. Therefore, the quantized space-time must be perturbed by the neutron whose gravitational diagram correspond to Fig. 1 and we must use the previously derived the equation for the quantum density ρ_2 of the medium inside the particle defined by the gravitational spherical interface with radius R_S [3, 4]:

$$\rho_2 = \rho_o \left(1 + \frac{R_g}{R_s}\right) \qquad (4)$$

Where R_S is the gravitational radius of the proton, m [4].

Physical processes preceding the formation of the gravitational diagram (Fig. 1) can be regarded as two separate cases equivalent to each other. The first case characterizes the compression of the quantized space-time by the gravitational interface to the state determined by equation (4). In the second case, the increase of the quantum density of the medium (4) inside the gravitational interface can be regarded as the transfer of the quantons from the external region of space to the internal region. A gravitational well forms on the external side, and the quantum density of the medium inside the particle increases by the value $\Delta\rho_2$ in comparison with the non-perturbed quantized space-time:

$$\Delta\rho_2 = \rho_2 - \rho_o = \rho_o \frac{R_g}{R_s} \qquad (5)$$

In Fig. 1, the increase of quantum density $\Delta\rho_2$ of the medium is indicated by the darkened area. The energy of spherical deformation W_0 of the quantized space-time in the formation of the neutron mass is determined on the basis of the equivalence of mass and energy [4]:

$$W_o = \int_0^{C_o^2} m_o d\varphi = m_o C_o^2 \qquad (6)$$

On the other hand, the energy of spherical deformation W_0 (3.56) [4] can be determined by the work for transferring the quantons from the external region through the gravitational interface into the internal region of the particle. This is determined by the energy conservation law. Further, it is necessary to determine the number of quantons Δn_2 transferred into the internal region of the particle. This can be determined quite easily knowing the volume of the neutron V_n in the present case, and the change of the quantum density of the medium in the internal region of the particle $\Delta\rho_2$ [4]:

$$\Delta n_2 = V_n \Delta\rho_2 = V_n \rho_o \frac{R_g}{R_s} \qquad (7)$$

The volume of the particle V_n is determined by the volume of its internal region, restricted by the radius R_S:

$$V_n = \frac{4}{3}\pi R_s^3 \qquad (8)$$

Taking into account (8), from (7) we determine the excess Δn_2 of quantons in the internal region of the particle:

$$\Delta n_2 = \frac{4}{3}\pi R_s^3 \Delta\rho_2 = \frac{4}{3}\pi R_s^2 R_g \rho_o \qquad (9)$$

The total number of the quantons n_2, situated in the internal region of the particle, is determined by the quantum density of the medium ρ_2 [4]:

$$n_2 = \frac{4}{3}\pi R_s^3 \rho_2 = \frac{4}{3}\pi R_s^3 \rho_o \left(1 + \frac{R_g}{R_s}\right) \qquad (10)$$

Knowing the number of excess quantons Δn_2 (9), transferred into the internal region of the particle, and the deformation energy $W_0 = m_0 C_0^2$ (3.160) of the quantized space-time, we determine the work W_q of the transfer of a single quanton from the external region of the quantized space-time to the internal region of the particle:

$$W_q = \frac{W_o}{\Delta n_2} = \frac{3 m_o C_o^2}{4\pi R_s^2 R_g \rho_o} \qquad (11)$$

Equation (11) can be simplified by expressing the gravitational radius R_g by its value (3.62) [4]:

$$W_q = \frac{W_o}{\Delta n_2} = \frac{3 C_o^4}{4\pi R_s^2 G \rho_o} \qquad (12)$$

`From equation (12) we remove the rest mass of the particle, although its limiting energy W_{max} does not appear there [4]:

$$W_{max} = \frac{C_o^4}{G} R_S \tag{13}$$

$$W_q = \frac{W_o}{\Delta n_2} = \frac{3}{4\pi R_s^3 \rho_o} \frac{C_o^4}{G} R_s \tag{14}$$

Thus, the work W_g for the transfer of a single quanton from the external region of the quantised space-time to the internal region of the particle is determined by the equations (11), (12), (6) and, on the other hand, it characterizes the work of exit of the quanton from the non-perturbed quantized space-time.

Undoubtedly, the determination of the work of exit of the quantum is a relatively complicated mathematical task, and the conditions of the task include the interaction of the monopoles inside the quanton with the entire set of the electrical and magnetic charges of other quantons in the local region of the deformed space. Therefore, it is proposed to use a simpler method which takes into account electromagnetic symmetry of the non-perturbed quantized space-time. For this purpose, we use the equation (3.168) according to which the work of exit of the quanton can be determined on the basis of the limiting energy of the particle W_{max} (13) and the number of quantons n_0 in the non-deformed region of space in the volume of the gravitational interface R_S:

$$W_q = \frac{W_{max}}{n_o} = \frac{3}{4\pi R_s^3 \rho_o} \frac{C_o^4}{G} R_s \tag{15}$$

Where:

$$n_o = \frac{4}{3} \pi R_s^3 \rho_o \tag{16}$$

In particular, the electromagnetic symmetry of the quantized space-time determines the equivalence of the energy of exit of the quanton with its internal electromagnetic energy (2.12), (2.70) [1] on the condition $L_{q0} = 2_{e0} = 2r_{g0}$:

$$W_q = \frac{1}{2\pi\varepsilon_o} \frac{e^2}{L_{qo}} + \frac{\mu_o}{2\pi} \frac{g^2}{L_{qo}} = \frac{1}{\pi\varepsilon_o} \frac{e^2}{L_{qo}} \tag{17}$$

Finally, equation (17) contains only the electrical parameters of the quanton which simplifies further calculations. The equivalence of the energy of exit of the quanton (12) to its internal electromagnetic energy (17) determines the continuity of the quantized space-time at the continuity of the quanton itself so that we can modify the equations (12) and (17):

$$W_q = \frac{3C_o^4}{4\pi R_s^2 G \rho_o} = \frac{1}{\pi\varepsilon_o} \frac{e^2}{L_{qo}} \tag{18}$$

From equality (18) we determine the required quantum density ρ_0 of the non-perturbed quantized space-time:

$$\rho_o = \frac{3\varepsilon_o C_o^4 L_{qo}}{4e^2 R_s^2 G} \tag{19}$$

Substituting (19) into (3) for the determination of the dimensions of the space quantum, we determine the required equality:

$$L_{qo} = \sqrt[3]{\frac{k_3}{\rho_o}} = \sqrt[3]{\frac{4k_3 e^2 R_s^2 G}{3C_o^4 \varepsilon_o L_q}} \tag{20}$$

Further, raising the left and right parts of the equations (20) to the cube and solving the equation with respect to the dimension of the quanton L_{q0}:

$$L_{qo}^4 = \frac{4}{3} k_3 \frac{1}{C_o^4} e^2 R_s^2 \frac{G}{\varepsilon_o} \tag{21}$$

From (21) we finally determine the diameter of the quanton L_{q0}:

$$L_{qo} = \frac{1}{C_o}\left(\frac{4}{3}k_3\right)^{\frac{1}{4}}\left(\frac{G}{\varepsilon_o}\right)^{\frac{1}{4}} \cdot \left(eR_s\right)^{\frac{1}{2}} \tag{22}$$

Equation (22) determines the diameter of the quanton for the non-perturbed quantized space-time which is a constant. It may be seen that all the parameters included in (22) are constants, with the exception of the radius of the gravitational interface R_S of the neutron. This means that the radius of the gravitational interface of the neutron is also a constant. The existing experimental procedures enable us to determine the root mean square radii of the proton and the neutron on the level of 0.81 F = $0.81 \cdot 10^{-15}$ m:

$$R_s = (0{,}814 \pm 0{,}015)F \approx 0{,}81 \cdot 10^{-15} m \tag{23}$$

Substituting (23) into (22) we obtain the numerical value of the diameter of the quanton (the space-time quantum):

$$L_{qo} = \frac{1}{C_o}\left(\frac{4}{3}k_3\right)^{\frac{1}{4}}\left(\frac{G}{\varepsilon_o}\right)^{\frac{1}{4}}\left(eR_s\right)^{\frac{1}{2}} =$$

$$= \frac{1}{3 \cdot 10^8}\left(\frac{4}{3}1{,}44\right)^{\frac{1}{4}}\left(\frac{6{,}67 \cdot 10^{-11}}{8{,}85 \cdot 10^{-12}}\right)^{\frac{1}{4}} \times \tag{24}$$

$$\times \left(1{,}6 \cdot 10^{-19} \cdot 0{,}81 \cdot 10^{-15}\right)^{\frac{1}{2}} = 0{,}74 \cdot 10^{-25} m$$

Regardless of the fact that the method of calculating the quanton diameter is based on the perturbation of the quantized space-time by the neutron, the resultant equation (16) holds for the quanton situated in the non-perturbed vacuum. This assumption is correct because the actual deformation of the quanton by the neutron is negligible in comparison with the quanton dimensions. This may be confirmed by substituting the neutron parameters into (3.18) [4]. In (2.7) [1] and in further sections, the final equation for the quanton diameter in the state unperturbed by gravitation is written in the following form:

$$L_{q\hat{\imath}} = \left(\frac{4}{3}k_3\frac{G}{\varepsilon_o}\right)^{\frac{1}{4}}\frac{\sqrt{eR_s}}{C_o} = 0{,}74\cdot 10^{-25}\,\mathrm{m} \qquad (25)$$

Thus, the dimensions of the quanton are determined by the linear length of the order of 10^{-25} m. It may be accepted that the length of 10^{-25} m is the fundamental length for our universe, determining the discreteness of the quantized space-time. This does not mean that in nature there are no dimensions smaller than the fundamental length. In comparison with the fundamental length of 10^{-25} m which determines the quanton dimensions, electrical and magnetic charges, including the structure of the monopoles, can be regarded as point formations with the size of the order of Planck length of 10^{-35} m. The actual displacements of the charges inside the quanton, as shown in chapter 2, are considerably smaller than the Planck length.

From (25) we determine the quantum density of the non-deformed quantized space-time

$$\rho_o = \frac{k_3}{L_q^3} = \frac{1{,}44}{L_q^3} = 3{,}55\cdot 10^{75}\,\frac{q}{m^3} \qquad (26)$$

Equation (26) shows that the quantum, together with the four electrical and magnetic quarks, is the most widely encountered particle in the universe and determines the structure of weightless quantized space-time, a medium with the unique properties.

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