Unit of Measurement of Magnetic Charge is Leon

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The problem of magnetic charge is the main scientific problem in creating the theory of Superunification. I knew the Dirac formula of magnetic charge for a magnetic monopole. Dirac considered the magnetic monopole as a free magnetic charge similar to a free electric charge. We observe experimentally the electrical charges. But the magnetic monopole was not discovered experimentally. This meant that the magnetic monopole does not exist in nature. But we observed magnetic fields. I perfectly understood that there should be a material carrier of a magnetic field in the form of a magnetic charge. The existing explanation that the cause of magnetism is electric current did not suit me. I found the correct answer to the question "Where is hidden magnetic charge?" in 1996. There is no magnetic monopole but inside the quanton there are integers magnetic quarks connected in pairs into magnetic dipoles. Magnetic quarks were first introduced into physics by me. Quanton consists of two magnetic and two electric quarks forming an electromagnetic quadrupole. Analyzing the electromagnetic properties of the quanton, I derived in 1996 the formula g = Ce correctly connecting magnetic g and electric e charges in the SI system through the speed of light C. The unit of measurement for magnetic charge is Leon: 1Leon is $4.8 \cdot 10^{-11}$ Am.

Keywords: magnetic quarks, electric quarks, magnetic monopole, electromagnetic quadrupole, quanton, theory of Superunification, magnetic charge is Leon.

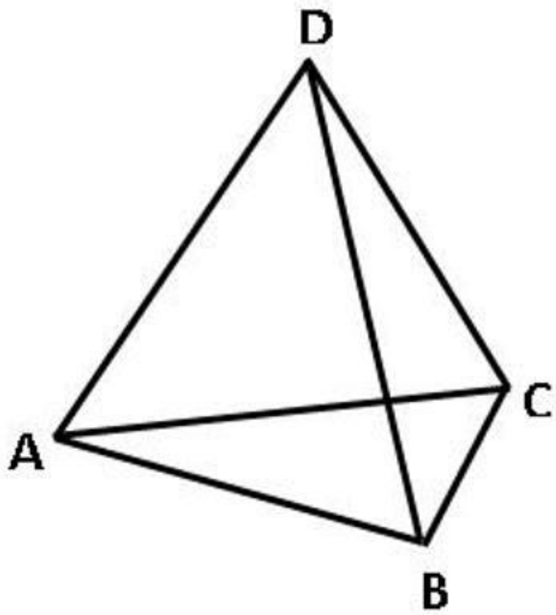

Fig. 1. The basis of a quanton is a tetrahedron.

In order to unify electricity and magnetism into a single substance, i.e. electromagnetism, it is necessary to avoid using the conventional coordinate systems and attempts to separate the elementary volume of the space using the numbers 1, 2, 3 and 4 for only four points (A, B. C. D) in space (Fig. 1). One such point does not give anything. Two points can be used to denote a line in space. The surface can already be covered by three points. Only four points can separate the volume in the form of a tetrahedron. Nature is constructed in such a manner that it tries to ensure minimization and rationalization. We should mention Einstein’s comment: ‘evidently, quantum phenomena show that the finite system with finite energy can be described fully by the finite set of numbers’ [1].

To transfer from the geometry of numbers to real physics, the numbers, denoting the tips of the tetrahedron must be given physical objects. In nature, there are no random coincidences as regards its fundamental situations. The physical objects are represented by four monopole charges– quarks: two electrical (+1*e* and –1*e*) and two magnetic (+1*g* and –1*g*), combined in the electromagnetic quadruple as a singular structure. Already the very fact of introduction of the electromagnetic quadrupole into theoretical physics requires attention because the properties of such a particle, combining electricity and magnetism, have never been analyzed. Figure 2 shows schematically in projection an electromagnetic quadrupole formed from electrical and magnetic monopoles in the form of spherical formations of finite dimensions with a central point charge. However, in this form the electromagnetic quadrupole does not yet correspond to the properties of the space-time quantum (quanton).

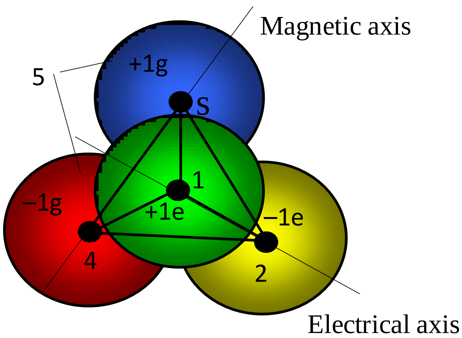

Fig. 2. The electromagnetic quadrupole (top view).

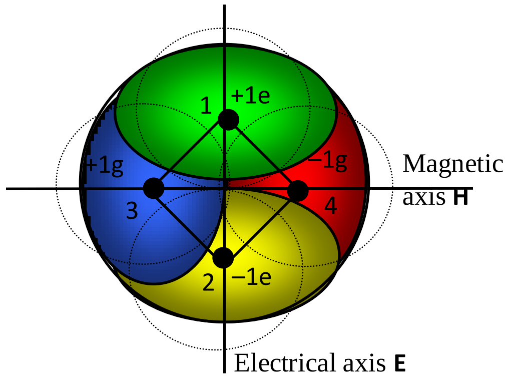

Fig. 3. The quanton in projection (rotated in space).

Naturally, it is necessary to ask: ‘what links together electricity and magnetism inside the electromagnetic quadrupole?’ The answer is a phenomenological, i.e., it is the superstrong electromagnetic interaction (SEI) representing also some sort of adhesive bonding various physical substances: electricity and magnetism. The realities of electromagnetism have been confirmed by experiments.

Figure 3 shows the space-time quantum (quanton) in the form of a spherical particle obtained as a result of electromagnetic compression of the quadrupole. Taking into account the colossal tensions between the charges inside a quanton, its stable state can be reached only when the quanton is spherical because this symmetry ensures compensation of the charges with opposite signs inside the quanton, determining it is the equilibrium state as the electrically and magnetically neutral particles. Thus, the discovery of the quantum as the carrier of superstrong electromagnetic interaction determines the electromagnetic properties of the quantized space-time which in the non-perturbed condition is regarded as a neutral medium [2–4].

The problem of the magnetic monopole was tackled by Dirac as an independent magnetic charge and in his honor it is referred to as the Dirac monopole [5–7]. Naturally, the search for magnetic monopoles and attempts to detect mass in them resulted in the experimental boom in the 60s which, however, has not yielded positive results. The Dirac monopoles have not been detected [7, 8]. The interest in them has been renewed because of the quantization of space-time in the EQM theory which regards the magnetic monopole as a non-free particle bonded in space-time and this particle cannot be detected in the free state. Only the indirect registration of the manifestation of the properties of magnetic monopoles in disruption of the magnetic equilibrium of the space-time in accordance with the Maxwell equations is possible.

The fact that the role of magnetic monopoles in the structure of the space-time was not understood prevented for a very long period of time the development of a method of determination of the value of the charge *g* of the magnetic monopole. Dirac himself assumed that taking into account the unambiguity of the phase of the wave function of the electron intersecting the line of *n*-nodes consisting of magnetic poles, we obtain the required relationship which in the SI system contains the multiplier $4\pi\varepsilon_0$ [5–7]:

$$g = 2\pi\varepsilon_o \frac{\hbar C_o}{e^2} en = 0{,}5\alpha^{-1} e\, n = 68{,}5en \tag{1}$$

Here $\hbar = 1.054 \cdot 10^{-34}$ J·s is the Planck constant, $\alpha = 1/137$ is the constant of the fine structure; $C_0 = 3 \cdot 10^8$ m/s is the speed of light in the vacuum, non-perturbed by gravitation; $\varepsilon_0 = 8.85 \cdot 10^{-12}$ F/m is the electrical constant; $\varepsilon = 1.6 \cdot 10^{-19}$ C is the electron charge, n is the integer multiplier.

The Dirac relationship (1) was improved by the well-known American theoretical physicist J. Schwinger who proved that *n* in equation (2) should only be an even number, and at n = 2 we obtain g = 137 e [8]

$$g = \alpha^{-1} e = 137e \tag{2}$$

However, the Dirac method is indirect in which *a line* of nodes can be separated in space from the magnetic charge included in the space-time structure. In reality, in the quantized only a line of quantons can be separated (Fig. 3) in the form of an alternating string from magnetic and electrical dipoles. In particular, Dirac did not take into account the electrical component of the effect. In movement of an electron along such an alternating string, the electron is subjected to the effect of waves from the side of the space-time which is characterized by the constant fine structure α. This was also taken into account nonformally by Schwinger by introducing n = 2.

It would appear that there is no basis for doubting Dirac's method which has been accepted by physicists and is regarded as a classic method. From the mathematical viewpoint, the Dirac solutions are accurate. However, from the viewpoint of physics, the Dirac procedure contradicts not only the structure of the quantized space-time but also the solutions of the Maxwell equations for the electromagnetic field in vacuum.

The main problem of the Maxwell equations was the explanation of the realities of bias currents. Until now, the explanation of the electrical bias currents has been contradicting, and we cannot even discuss the magnetic bias currents, although Heaviside attempted to represent the bias points in the total volume. The introduction of the quanton into the structure of the space-time makes the electrical and magnetic bias currents realistic as a result of electromagnetic polarization of vacuum as the carrier of SEI.

We write the Maxwell equations for the vacuum, expressing the density of the electrical $\mathbf{j}_e$ and magnetic $\mathbf{j}_g$ bias currents in the passage of a flat electromagnetic wave through the space-time by the time dependence t of the strength of the electrical **E** and magnetic **H** fields in the form of the system:

$$\begin{cases} \mathbf{j}_e = \mathrm{rot}\mathbf{H} = \varepsilon_o \dfrac{\partial \mathbf{E}}{\partial t} \\ \mathbf{j}_g = \dfrac{1}{\mu_o}\mathrm{rot}\mathbf{E} = -\dfrac{\partial \mathbf{H}}{\partial t} \end{cases} \tag{3}$$

where $\mu_0 = 1.26 \cdot 10^{-6}$ H/m is the magnetic constant.

The system (3) reflects the symmetry of electricity and magnetism in the quantized space-time. The equations (3) are presented in the form published by the outstanding English physicist and mathematician Heaviside who introduced into Maxwell equations additional magnetic bias currents, determined by magnetic charges, giving the equations the completed symmetrical form.

The solution of the system (3) will be sought for the real relationship between the magnetic and electrical elementary charges inside a quanton which determines their bias currents in the quantized space-time. For this purpose, the densities of the bias currents $\mathbf{j}_e$ and $\mathbf{j}_g$ in (3) are expressed by the speed of displacement **v** of the elementary electrical e and magnetic g charges – quarks inside the space-time and the quantum density of the medium ρ_0 which determines the concentration of the quanta of the space-time in the unit volume:

$$\begin{cases} \mathbf{j}_e = 2e\rho_o\mathbf{v} \\ \mathbf{j}_g = 2g\rho_o\mathbf{v} \end{cases} \tag{4}$$

The multiplier in (4) is defined on the basis of the fact that the charges e and g are included in the composition of the space-time inside the quanton by pairs with the sign (+) and (–), forming on the whole a neutral medium. Taking into account fact that in the actual conditions the electromagnetic polarization of space-time is associated with the very small displacement of the charges in relation to their equilibrium position, the speed of their displacement **v** is the same.

The problems of polarization of the quantum have been examined in greater detail in [9, 10] in analytical derivation of the Maxwell equations. At the moment, it is important to understand that all the electromagnetic Maxwell processes in vacuum are associated with the constancy of the internal energy of the quanton in its electromagnetic polarization. Extending the quanton (Fig. 3) along the electrical axis, we also observe compression of the quanton along the magnetic axis. This is accompanied by the displacement of the charges inside the quanton which also determines the realties of the currents (4) of electrical and magnetic bias.

Attention should be given to the fact that the electrical and magnetic axes of the quanton (Fig. 2.2b) are unfolded in the space of the angle of 90°, determining the space shift between the vectors of the strength of the electrical **E** and magnetic **H** fields in all electromagnetic wave processes, and also determining the direction of the vector of speed **C** of propagation of the electromagnetic wave, the vector of the speed of light $\mathbf{C}_0$ in vacuum, non-perturbed by gravitation, is denoted by the parameters of the electromagnetic field. The ratio of these parameters was obtained in analytical derivation of the Maxwell equations [9, 10]:

$$\frac{1}{\varepsilon_o}\frac{\partial\ \mathbf{H}}{\partial\ \mathbf{E}} = \mathbf{C}_o \tag{5}$$

In fact, (5) is also the form of the singular Maxwell vector equation for vacuum in which the vector of speed of light $\mathbf{C}_0$ is situated in the plane of the orthogonal plane of the vectors **E** and **H** and the simultaneous change of the vectors with time also generates the electromagnetic wave.

Substituting (4) into (3) and taking (5) into account, we obtain the true relationship between the magnetic and electrical monopoles in the quantized space-time:

$$g = C_o e = 4{,}8 \cdot 10^{-11}\,\text{Am}\ \ (\text{Leon}) \tag{6}$$

In the theory of Superunification, all the calculations are carried out in the SI system. Therefore, in the SI system the dimension of the magnetic charge is defined as [Am] since the dimension of the magnetic momentum is [Am^2]. According to Dirac and Schwinger, the dimension of the magnetic and electrical charges is the same [C]. This is very convenient because it determines the symmetry between electricity and magnetism which in the ideal case would be expressed in the completely equal values of the magnetic and electrical monopoles. It turns out that Dirac and Schwinger were mistaken in calculating the magnetic charge g increasing it by 68.5 (1) and 137 (2) times. Their calculation methodology turned out to be incorrect. I fixed the error of Dirac and Schwinger and got the right solution (6).

The unit of measurement for magnetic charge is Leon [L].

Formula (6) establishes the absolute symmetry (equality) between electricity and magnetism within the quantized space-time. However, in the SI system, the dimensions of magnetism are determined by electrical current. Therefore, the equality between the magnetic and electrical charges in (6) is linked by the dimensional multiplier C_0 and the dimension of the magnetic charge in the SI system [Am]. At the moment, it is an arbitrary dimension but I assume that with time it will be officially accepted. I calculated and published formula (6) in 1996 [11, 12].

Symmetry of electricity and magnetism inside a quanton. The uniqueness of the Maxwell equations (3) and (5) for vacuum is manifested in the complete symmetry between electricity and magnetism. To understand the reasons for this symmetry, we analyze the Coulomb forces inside a quanton (Fig. 3). The fact is that the Coulomb law is a precursor of the Maxwell equations and the most extensively verified fundamental law.

The symmetry of electricity and magnetism inside a quanton (Fig. 3) may be demonstrated as follows. Into the Coulomb law we introduce, separately for electrical and magnetic charges, the equation (6) at the distance between the charges determined by the side of the tetrahedron equal to 0.5 L_{qo}. Consequently, Coulomb forces F_e and F_g as the attraction forces inside the quanton for the electrical charges and for magnetic charges, respectively, should be equal, i.e. $F_e = F_g$.

The calculated diameter of the quanton L_{qo} for the non-perturbed quantized space-time, determined from the condition of elastic tensioning of space-time in generation in the quanton of elementary particles (nucleons) with the mass [4,13]:

$$L_{qo} = 0{,}74 \cdot 10^{-25}\,\mathrm{m} \tag{7}$$

We use the reversed procedure. We write the Coulomb law inside the quanton for electrical charges and for magnetic charges on the condition of the equality of force electrical and magnetic components $F_e = F_g$ and the equality of the distances r_{oe} and r_{og} between the electrical and magnetic charges, respectively:

$$r_{eo} = r_{go} = 0{,}5L_{qo} = 0{,}37 \cdot 10^{-25}\,\mathrm{m} \tag{8}$$

$$\begin{cases} F_e = \dfrac{1}{4\pi\varepsilon_o}\dfrac{e^2}{r_{eo}^2} = 1{,}6\cdot 10^{23}\,\mathrm{N} \\ F_e = F_g \\ F_g = \dfrac{\mu_o}{4\pi}\dfrac{g^2}{r_{go}^2} = 1{,}6\cdot 10^{23}\,\mathrm{N} \end{cases} \tag{9}$$

Next, we equate the electric and magnetic forces (9) inside the quanton:

$$\frac{1}{4\pi\varepsilon_o}\frac{e^2}{r_{eo}^2} = \frac{\mu_o}{4\pi}\frac{g^2}{r_{go}^2} \tag{10}$$

The solution of the system (9, 10) is obtained under the condition $\varepsilon_0\mu_0 C_0^2=1$:

$$g = \sqrt{\frac{1}{\varepsilon_o\mu_o}}\;e = C_o e \tag{11}$$

It may be seen that only when the parameters of the electrical and magnetic components inside the quanton are equal, in particular for the Coulomb forces (10), the relationship (11) between the values of the elementary magnetic and electrical charges corresponds to the previously determined relationship (6). Shorter distances between the charges inside the quanton determine colossal attraction forces (10) which characterize the quantized space-time by colossal elasticity.

Thus, the electromagnetic symmetry of the quanton determines the relationships (6) and (11) and also the correspondence of these relationships to the Maxwell equations (3) and the Coulomb law (10). The Dirac relationship (1) does not correspond to (3) and (10), is not written in the SI system and uses the procedure based on the unambiguous yield of the phase of the wave function of the electron whose parameters include not only the elementary electrical charge *e* but also other parameters, which determine the wave properties of the electron in the quantized space-time. It should be accepted that as regards the procedure, Dirac made an error but this does not reduce role in the investigations of the magnetic monopole. In the pure form, the monopole elementary electrical and magnetic charges are included only in the structure of the quanton, and the analysis of the properties of the quanton yielded the true relationships (6) and (11).

In fact, the forces (10) inside the quanton are colossal in magnitude and comparable with the attraction forces of the Earth to the Sun. These forces determine the colossal elasticity of the quantized space-time in the theory of the theory of Superunification which investigates the structure of vacuum. In particular, when examining the domain of the ultra-microworld of the quanton, the theory of Superunification has had to face the colossal forces attention and energy concentration.

We verify the energy symmetry of the quantum, analyzing the energy of electrical W_e and magnetic W_g components of the charges interacting inside the quanton under the condition (9):

$$\begin{cases} W_e = \dfrac{1}{4\pi\varepsilon_o}\dfrac{e^2}{r_{eo}} = 0{,}62\cdot 10^{-2}\,\mathrm{J} \\ W_g = \dfrac{\mu_o}{4\pi}\dfrac{g^2}{r_{go}} = 0{,}62\cdot 10^{-2}\,\mathrm{J} \end{cases} \qquad (12)$$

As indicated by (12), the energies of interaction of the electrical charges and the magnetic charges inside the quanton are equal to each other, as are also the Coulomb forces (10). This property of the quantum determines the total electromagnetic symmetry of the quantized space-time.

Next, we equate the electric and magnetic energy (12) inside the quanton:

$$\frac{1}{4\pi\varepsilon_o}\frac{e^2}{r_{eo}} = \frac{\mu_o}{4\pi}\frac{g^2}{r_{go}} \qquad (13)$$

The solution of the system (12, 13) is obtained under the condition $\varepsilon_0\mu_0C_0^2=1$ and it is also equal to formula (6):

$$g = C_o e \quad (14)$$

Formulas (6), (11) and (14) are equivalent, although obtained by different methods.

Thus, the introduction into physics of the space-time quantum (quanton) enables us to understand the principle of electromagnetic symmetry and also penetrate into the depth of electromagnetic processes on the level of the fundamental length 10^{-25} m. Prior to the development of the theory of Superunification, physics did not have these unique procedural possibilities.

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