The electromagnetic nature of the Newton law of gravitation

Victor Kuligin and Maria Korneva

Department of an electronics, Physical faculty, Voronezh State University,
Universitetskaya Sq. 1, Voronezh, 394018, Russia
E-mail: victor_kuligin@mail.ru, maxa63@mail.ru

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Abstract: The main source of problems in GRT is indicated. Physicists and geometers in explaining phenomena do not take into account the simultaneous existence of two spaces (linear space-time and curvilinear space-time). The initial assumptions of GRT (the hypothesis of equivalence of inertial and gravitational masses) are described and analyzed. It is shown that the principle of equivalence of the masses is philosophically incorrect, and the “experimental verification” of the hypothesis is difficult because of the lack of accuracy of the measuring devices. The idea of J. Thomson (*J.J. Thomson*. 1856-1940) about the electromagnetic nature of material bodies is developed. It is shown that gravity is the square effect of Coulomb's law. It has been established that the idea of “maxwellization” of Newton’s theory excellently supports the idea of J. Thomson about the electromagnetic nature of inertial matter.

1. Introduction

The idea of the electromagnetic nature of matter was put forward at the end of the 19th century by the great English scientist Thomson. The following circumstance hindered the idea of implementation of "maxwellization" of the Newton theory of gravity. An analysis [1] showed that the energy conservation law formulated by Poynting was limited by electromagnetic waves and was completely unsuitable for use for instantaneous charge fields.

The problem of electromagnetic mass in the non-relativistic approximation was solved after the proof of two energy conservation laws: Umov’s conservation law and Lenz’s conservation law [1]. Based on these laws, it was proved that the electromagnetic mass has the same properties as the standard inertial mass (electromagnetic mass m_e, pulse $\mathbf{P}_e = m_e\mathbf{v}$, kinetic energy $E_k = m_e v^2/2$). Umov’s conservation law in a relativistic-covariant form was formulated later (see, for example, [2]).

However, the establishment of the electromagnetic nature of matter did not end there. The problem of electromagnetic mass was solved, the theory of interaction of electric charges perfectly fit into the framework of classical mechanics [2]. However, the Newton’s law of gravitation “did not fit” in the framework of electromagnetic representations.

The analogy between the Coulomb’s law and the law of gravitation of Newton, which would allow consider gravitational phenomena as quadratic phenomena of electrodynamics, was suggested. Two circumstances prevented idea of “maxwellization” theory. The first circumstance is GRT, created by A. Einstein. GRT advocates have hampered the publication of critical articles and alternative approaches. The second problem was a logical difficulty. Large bodies (stars, planets, material objects) are electrically neutral. How can we connect the electric charges and the phenomenon of neutral bodies?

GRT did not justify the hopes of scientists. “Black holes”, “Dark matter”, “Big Bang” and other oddities of the phenomena predicted by GRT required logical explanations. Finding the source of the problems led us to discover an interesting fact. The fact is that about 200 years ago, geometers made a mistake [3].

The essence of the error is simple. It is fundamentally impossible to build a curvilinear space-time without relying on Euclidean space and classical time. Theorists acted simply: they built curvilinear space-time in a linear space-time, setting the metric tensor $g_{\propto\beta}(x, y, z, t)$.

With further analysis, they “safely forgot” about the original linear space-time. Due to this circumstance, the problem of rethinking and new wording of explanations of phenomena in the framework of GRT arises. This is the most difficult and, in our opinion, impossible task.

In addition, the Einstein idea of the equivalence of inertial and gravitational masses is erroneous from the point of view of materialistic philosophy[1].

2. Proportionality or equivalence?

In non-relativistic mechanics, there are two concepts of mass: the first refers to the second law of Newton, and the second to the Newton’s gravitational force law.

1. The first mass, inertial, is the ratio of non-gravitational force acting on the body to its acceleration.
2. The second mass, gravitational, determines the force of attraction of the body by other bodies and its own force of attraction.

These two masses are measured in different experiments, so they are absolutely not obliged to be connected, and even more so – proportional to each other.

In modern physics, the opinion was strengthened that the strict proportionality of these masses was experimentally established. This allows us to speak of a single body mass, both in non-gravitational and gravitational interactions. A suitable choice of units can make these masses equal to each other. “Strong proportionality” can have several explanations. We will look at two models.

The rule of proportionality of the masses. The first model states that inertia and gravity are of a *different nature*. However, due to some properties of matter, proportionality between the masses takes place in a wide range of conditions. The rule has limits of applicability beyond which it is violated.

The equivalence of the masses postulate[2]. Creating GRT, Einstein proposed to quantitatively equate inertial and gravitational masses. From a philosophical point of view, this hypothesis is untenable, since quantitative equality inevitably leads to the identification of qualitative properties. Therefore, in physics, the opinion was affirmed that gravitational and inertial forces have the same nature.

The two approaches outlined are fundamentally different. We need to discuss the characteristics of each approach. From the point of view of experimental verification, both

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[1] Analysis of the postulates of A. Einstein showed that he did not understand physics well and also did not understand philosophy.

[2] The postulate (axiom) is a position taken within the framework of the theory as evidence true. First, “evidence” is not proof of truth. Suffice it to recall Ptolemy's "obvious" geocentric system. Secondly, any postulate has no limits of applicability. It is fair "for all times and nations." The postulate is a hypothesis which has been given the status of absolute truth (dogma).

approaches are the same. Therefore, the confirmation of the mass equivalence postulate automatically confirms the principle of mass proportionality. In [4], [5] in the framework of classical mechanics, it was theoretically proved that the principle of proportionality of inertial and gravitational masses holds for two interacting bodies. We can offer a direct way to test the mass equivalence hypothesis. In classical physics, there is the principle of "independence of pair interactions". Two objects interact with each other, regardless of their private interactions with other bodies. Using only two bodies, we cannot verify the principle of mass equivalence.

The interaction of the three bodies. As an illustration, we will look at the interaction of the sun with the earth-moon system. We will write the Lagrange function for this system.

$$L = \frac{MV_S^2}{2} + \frac{m_E v_E^2}{2} + \frac{m_M v_M^2}{2} + G\frac{Mm_E}{R_{SE}} + G\frac{Mm_M}{R_{SM}} + G\frac{m_M m_E}{R_{ME}} \qquad (2.1)$$

where: M is the mass of the sun; V_S is the speed of the sun; m_E is the mass of the earth; v_E is the speed of the earth; R_{SE} is the distance from the earth to the sun; m_M is the mass of the moon; v_M is the speed of the moon.

The solar mass M interacts with two masses m_E and m_M. This is the gravitational mass of the earth and the gravitational mass of the moon. If, say, the earth and the moon are far apart, then the energy of interaction between them is small. However, even this low interaction energy may has some inertial mass

$$\Delta m^* = -\frac{W_{EM}}{c^2} = -G\frac{m_M m_E}{R_{ME}c^2} \qquad (2.2)$$

The sign "-" in the formula is due to the fact that the interaction energy is negative. If the principle of equivalence of masses takes place, then the sun must have a gravitational interaction with this mass. However, in the framework of classical mechanics, such an interaction is absent due to the principle of independence of pairwise interactions.

So, we have come to the possibility of direct experimental verification of the equivalence principle. It is necessary to establish: does the massΔm^* have gravitational properties or not?

In a series of experimental studies, we did not find a similar formulation of the question. The estimate shows to establish the gravitational properties of Δm^* very high accuracy is needed (above 10^{-17}). Now we can say the principle of mass proportionality has a good experimental confirmation. However, the principle of equivalence of the masses, proving the unified nature of gravity and inertia, has not yet had experimental confirmation or experimental refutation.

3. The square effect of electrodynamics

As we wrote earlier, the great scientist D. Thomson drew the attention to the analogy between the quasi-static phenomena of electrodynamics and mechanics. He expressed the idea of the electromagnetic nature of material objects with inertia. We will continue to develop the Thomson idea and will show that gravity is a quadratic effect of electrodynamics.

Indeed, if we write down the Coulomb's law for static charges and the Newton's law of universal gravitation, then the similarity of laws is surprising. We write the Lagrange functions:

1. Coulomb's law $\quad L_q = -\frac{q_1 q_2}{4\pi\varepsilon R} \quad$ (3.1)
2. Newton's law of universal gravitation $\quad L_g = G\frac{m_1 m_2}{R} \quad$ (3.2)

Next, we can generalize the Lagrange function to the case of relative motion of charges, when the electrostatic potential L_q depends on the relative velocity of charges. We write the Lagrange function for this case.

3. Coulomb's law with potentials depending on the relative velocity of charges v_{12} is: $L_q = -\frac{q_1 q_2}{4\pi\varepsilon R}(1 - \frac{v_{12}}{2c^2} + \cdots)$ (3.3)
4. Using the similarity principle, we can Write the generalized Lagrange function for the expression (3.2): $L_g = G\frac{m_1 m_2}{R}(1 - \frac{v_{12}}{2c^2} + \cdots)$ (3.4)

We see that the results of calculations coincide with the results of SRT, if $v \ll c$.

To avoid ambiguous interpretation, we will first consider “maxwellization” using the example of a single charged particle — a proton. We write below the Lagrange function for the interaction of two protons (3.3), adding to it quadratic terms:

$$L_q = -\frac{1}{4\pi\varepsilon R}[q_1 q_2 - k(q_1 q_2)^2 + \cdots](1 - \frac{v_{12}}{2c^2} + \cdots) \quad (3.5)$$

where: q_1, q_2 are the charges of the first and second protons, R_{12} is the relative distance between protons, v_{12} is the relative speed of the protons.

So, we have an expression that allows us to show the electromagnetic nature of gravity.

Using expression (3.5) we write the formulas for each member of the sum in square brackets separately:

5. $L_{1q} = -\frac{q_1 q_2}{4\pi\varepsilon R}(1 - \frac{v_{12}}{2c^2} + \cdots)$ (3.6)
   It is easy to see that expression (3.6) is the standard Lagrangian (3.3) written above.
6. $L_{2q} = +\frac{k(q_1 q_2)^2}{4\pi\varepsilon R}(1 - \frac{v_{12}}{2c^2} + \cdots)$ (3.7)
   Expression (3.7) is very similar to the Lagrange function for the Newton's law of universal gravitation (3.4).

Expressions (3.4) and (3.7) will coincide if we assume that the gravitational charge of the particle is proportional to the square of the electric charge of this particle q^2. For convenience, we will select the desired value of the coefficient k such that the units of measurement of inertial and gravitational masses coincide.

The interaction of two protons

Large inertial masses (for example, planets) do not have an excess charge. They are electrically neutral. Therefore, we begin the analysis with the interaction of two charged particles - protons. For simplicity, we will assume that the relative velocity of the interacting bodies is zero. The coefficient k for the proton is denoted by k_p.

In order for the identity to take place between expressions (3.4) and (3.7), the corresponding terms must be equal. For identical protons, we have:

$$\frac{k_p(q)^4}{4\pi\varepsilon} = G_0 m_p^2 \quad (4.1)$$

where G_0 is the gravitational constant of protons.

In the right side of expression (4.1) there should be gravitational charges of protons. To distinguish them from the inertial mass m_p, in the expression (4.1) we replace m_p with m_p^*. The gravitational charge is proportional to the square of the electric charge and is always positive.

Now the gravitational charge and inertial mass of the proton will not only be numerically equal, but will also be measured by common units, if the coefficient k_p is equal to

$$k_p = \frac{m_P^{*2}}{q^4} 4\pi\varepsilon G_0. \qquad (4.2)$$

Now the unit of measurement of the gravitational charge of the proton and its inertial mass is the kilogram (SI).

It remains to recall that the inertial mass of the resting charge is equal to:

$$m_P = \int \frac{\rho\varphi}{2c^2} dV = \int \frac{\varepsilon(grad\varphi)^2}{2c^2} dV \qquad (4.3)$$

We have chosen the proportionality coefficient so that the ratio of the gravitational charge of the proton to its inertial mass is always 1 ($s_P = \frac{m_P^*}{m_P} = 1$). There are other charged particles: electrons, ions. There are also neutral particles: neutrons, neutral atoms and molecules, etc. We will look at them in the next paragraph. Proton will continue to serve as a benchmark for comparison.

5. The Mendeleev's periodic table and the rule of proportionality

We consider the periodic table (Fig. 2). In each cell occupied by a chemical element, there are two numbers. In Fig. 2 the upper digit indicates the ordinal number of the element. It informs about the number of protons (or electrons) in a neutral atom ($n_e = n_P$). The bottom number indicates the atomic mass of the element. Atomic mass is a dimensionless quantity. It is defined as the ratio of the mass of an atom of a given element to 1/12 the mass of a neutral atom of the carbon isotope $^{12}C_6$. For any isotope, atomic mass is an integer. It is equal to the sum of neutrons and protons in a given isotope ($n_N + n_P$).

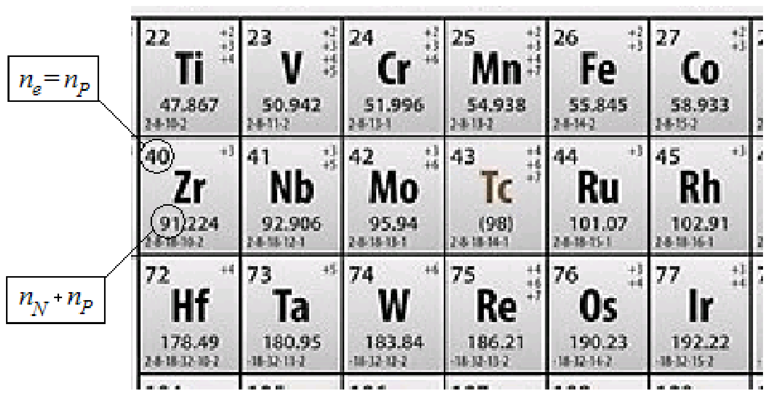

Fig.2. Fragment of the periodic table

Because of the choice of the coefficient k_p, we established the same dimension of gravitational charges and inertial masses. Therefore, we can use dimensionless units of atomic masses.

Each cell of the table has a sequence number of an element equal to the number of protons (electrons) in the neutral atom of this element. The table also indicates the relative atomic mass (weight) of this element. The atomic mass of any isotope is numerically equal to the sum of the number of neutrons and protons (n_N+ n_P). Now we can refer to the periodic table and select any element from this table. We will choose zirconium $^{91}Zr_{40}$ as an example.

Inertial mass of zirconium $^{91}Zr_{40}$ $(n_N + n_P = 91;\ n_P = n_e = 40)$.

The inertial mass of an atom is numerically equal to the mass sum of protons, electrons and neutrons. In our case, the inertial mass of the proton is equal to 1, the inertial mass of the neutron is also approximately equal to 1, and the inertial mass of the electron is 1860 times smaller than the mass of the proton. So, the inertial mass of zirconium $^{91}Zr_{40}$ in atomic units is equal to:

$$m = n_N + n_P + n_e/1860 = n_N + n_P + n_P/1860 \approx n_N + n_P \qquad (5.1)$$

The contribution of electrons to the total inertial mass is very small and can be neglected.

Zirconium gravitational charge $^{91}Zr_{40}$ $(n_N + n_P = 91;\ n_P = n_e = 40)$.

First, we determine the gravitational charge of the neutron. The neutron is a compound of electron and proton. Therefore, the gravitational charge of the neutron is 2. The proton and the electron have equal electric charges. In a neutral atom, the number of electrons is equal to the number of protons $n_e = n_P$). The gravitational charge of the proton is 1, and the gravitational charge of the electron is equal to the gravitational charge of the proton, i.e. is also equal to 1. It is easy to calculate the gravitational charge of the neutral circonium atom (*atomic units*).

$$m^* = 2n_N + n_P + n_e = 2(n_N + n_P) \qquad (5.2)$$

The rule of proportionality

It is easy to see that the ratio of the gravitational charge $m^*$to the inertial mass m for $^{91}Zr_{40}$ is approximately equal to 2.

$$s = \frac{m^*}{m} \approx \frac{2n_N\ (\text{neutron}) + n_P(\text{proton}) + n_e(\text{electron})}{n_N(\text{neutron}) + n_P(\text{proton})} = 2 \qquad (5.3)$$

It is interesting to note that $s = \frac{m^*}{m} \approx 2$ not only for any neutral element of the periodic table. Expression (5.3) reflects the proportionality of inertial mass and gravitational charge for any neutral massive bodies (solids, liquids). The reason is that the addition of masses to the inertial masses of atoms due to the interaction of ions of a solid or liquid substance with each other is very small and is a fraction of a percent.

Examples of various parameters *s*

Considering the proton, we found that for the proton the value $s_P = \frac{m^*}{m} = 1$.. For electrons $s_e = 1860$. Another example of a "violation" of the proportionality rule is any ion. As an example, we consider the ∝-particle. It is a doubly ionized helium atom He^{++}. For ∝-particle s value is equal to

$$s_{He^{++}} = \frac{4n_P + 2n_N}{2n_P + 2n_N} \approx 1{,}5 \qquad (5.4)$$

Thus, the ionized molecules do not obey the mass ratio of 2, which is valid for the neutral molecules of the periodic table.

The gravitational constant *G*

Scientists measure the gravitational constant using Newton's law and electrically neutral masses. This law includes inertial masses, not gravitational charges proportional to them. We must find the gravity constant $G_{0.}$. We can use the expression (4.1). If in this law for electrically neutral bodies replace the inertial mass of the proton by the gravitational charge, then we get

$$Gm_1m_2 = G_0m_1^*\, m_2^* = Gm_1^*\, m_2^*/s^2 \qquad (5.5)$$

where $G = G_0 s^2$ is the gravitational constant *experimentally* measured for neutral bodies; G_0 is the fundamental gravity constant, $m_1, = m_2$ inertial masses of protons, $m_1^* = m_2^*$ gravitational masses of protons.

Since for neutral bodies for which measurements were made, the ratio $s = 2$, the experimentally found value of the gravitational constant G and the fundamental constant $G_{0.}$ is determined by the formula

$$G = 4G_0 \qquad (5.6)$$

The Newton's universal law of the world for neutral bodies has the following form

$$F = G_0 \frac{m_1^* m_2^*}{R^2}\left(1 - \frac{v_{12}}{2c^2} + \cdots\right) = G\frac{m_1^* m_2^*}{R^2 s^2}\left(1 - \frac{v_{12}}{2c^2} + \cdots\right) = G\frac{m_1 m_2}{R^2}(1 - \frac{v_{12}}{2c^2} + \cdots) \qquad (5.7)$$

This is the Newton's usual law of the world. In general case, the law is:

$$F = G_0 \frac{m_1^* m_2^*}{R^2}\left(1 - \frac{v_{12}}{2c^2} + \cdots\right) = G\frac{m_1^* m_2^*}{R^2 s_1 s_2}\left(1 - \frac{v_{12}}{2c^2} + \cdots\right) = G\frac{4}{s_1 s_2}\frac{m_1 m_2}{R^2}(1 - \frac{v_{12}}{2c^2} + \cdots) \quad (5.8)$$

We see that the Newton's law of gravitation must be “corrected” for various interacting objects (electrically neutral bodies, charges, ions). This fact is reflected with the factors s of the law of world gravitation.

So, the "maxwellization" of the equations of gravitation allowed to find a new interpretation of the physical nature of the gravitation. Quantitatively, for neutral material bodies, the Newton’law of universal gravitation has not changed, but the nature of the phenomena has become different.

The "atmosphere" of the sun.

Now we can illustrate the structural features of the solar "atmosphere", based on the results obtained. Suppose that different particles fly out at the same speeds and stop under the action of the forces of the sun. The particles have the following lifting heights (conventional units):

Electrons	$h_e =$ 1
Neutral atoms (H, He)	$h_a =$ 930
He^{++} ions	$h_{He^{++}} =$ 1240
Protons	$h_P =$ 1860

First of all, we note that the kinetic energy of electrons is much less than the kinetic energy of alpha particles, hydrogen atoms and helium. Their energy is too low to overcome the forces of gravitation. For this reason, we can assume that a relatively “thin” layer of electrons with a fairly high concentration can exist near the surface of the sun. As the distance from the sun increases, the concentration of particles will decrease. At large distances from the sun, the interplanetary space charge will have a positive sign. Planets, moving in the field of charged particles, always acquire a small electrical charge.

If the total charge of the negative "electron shell" near the sun is several hundred Coulomb, then between the charged planet and the electron "shell" of the sun there is a Coulomb interaction, which must be taken into account.

It is especially important to take these phenomena into account when evaluating the effect of flares on the sun. As the alpha particle flux increases, the radius of the planet's trajectory slightly increases, the duration of the day on the planets changes, etc. Coulomb’s forces can introduce errors in experimental measurements.

6. Conclusion

The idea of J. Thomson about the electromagnetic nature of inertial matter proved fruitful. We have already solved the electromagnetic mass problem and showed that the inertial mass of a charge has all the basic qualities of a mechanical inertial mass.
In this work, we have shown that the phenomena of gravitation can be considered as a quadratic effect of quasi-static electrodynamics. The quasi-static phenomena of electrodynamics and the phenomenon of gravity can now be explained from a unified position. There are no internal logical contradictions in the new approach. Moreover it does not need doubtful hypotheses.

Any inertial mass is the sum of two inertial masses. The first mass is positive electromagnetic, the second mass is negative gravitational. We have not described the theory of gravitational potential, light, etc. These problems need to be published in a separate article.

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