ON SOME JOINT LAWS OF THE FIELD OF GRAVITY AND ELECTROMETRY

Vasil Tchaban, Dr. Sc., Prof.
Lviv Polytechnic National University, Lviv National Agrarian University
Ukraine, e-mail: v1z4d5@gmail.com

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Abstract. Adapted laws of statics of electric and gravitational fields in case of dynamic processes are used to obtain common laws of electricity and gravity. The mathematical description is made in a possible range of velocities in the usual three-dimensional Euclidean space and physical time, but bypassing the theory of relativity. This takes into account the finite speed of light propagation of electric and gravitational fields. For certainty, the derivation of the obtained results of gravity is duplicated by the methods of classical mechanics. Wave equations are obtained. The necessary attention is paid to the ratio of dimensions of parallel electrical and mechanical quantities.

Key words: Electric and gravitational field, three-dimensional Euclidean space, physical time, all possible speed range, world velocity of field propagation, common laws of electricity, and gravity.

1. Introduction

To approximate the methods of gravimetry and electrometry of moving physical bodies, it is useful to have some common laws, which by the principle of analogy and proportionality of the dimensions of physical quantities would appear in a common mathematical image. In this article, an attempt is made to implement this idea on the example of gravitational and electric inhomogeneous vortex fields. Since the speed of motion is not subject to any restrictions, mathematical images must reproduce all possible effects of motion, both stationary and vortex. Such a problem is not easy, but, as its analysis has shown, it is further complicated by the theory of relativism, realized in a distorted Riemannian space based on a non-energetic action functional – the scalar curvature of the Ricci tensor. Therefore, a reasonable question arises, and why not simplify the task by adapting the laws of statics of both fields to the case of motion in the usual three-dimensional space and physical time. Moreover, this possibility was pointed out by G. Poincare at the dawn of the theory of relativism [1], and even more so by modern experts in the field of space-time [3]. In a similar vein, we wrote a previous article on the pages of this magazine [2]. Therefore, this should be interpreted as a direct continuation and generalization of [2].

2. Theoretical part

Basic laws of statics

The basis of unifying efforts is the experimental laws of statics: Newton's law of universal gravitation (1687) and Coulomb's law of electric interaction (1785). But for the sake of the set purpose, they should be adapted in case of their moving components – mechanical masses and electric masses (charges).

Newton's well-known experimental law of universal gravitation describes the gravitational force of stationary masses

$$\mathbf{F} = \gamma \frac{m_1 m_2}{r^2} \mathbf{r}_0, \qquad (1)$$

where F is the force of gravity between two gravitational masses m_1, m_2; r is the instantaneous distance between the centers of mass; γ is the gravitational constant; $\mathbf{r}_0$ is the unit spatial vector.

For moving masses in the range of prerelativistic velocities, the law (1) provides sufficient accuracy, so it is still widely used in practice not only in terrestrial conditions but also in space research. Thus, significant corrections for the movement of Mercury accumulate over a hundred years, and for the Earth, they are almost impossible to notice. Even in the study of galaxy clusters, in which the average density of matter is low, astrophysicists continue to use Newton's approximation.

The experimental law of electrical interaction of point-tuned bodies of Ch. Coulomb laid the foundations of electrostatics. The law describes the electrical force interaction of stationary tuned bodies. It is quite similar to the law (1):

$$\mathbf{F} = k \frac{q_1 q_2}{r^2} \mathbf{r}_0, \qquad (2)$$

where F is the vector of forces of interacting charged bodies with charges q_1 and q_2; r is the distance between the electrical centers of bodies; k is electrical constant.

The interaction of moving electric charges is the main process in all electronic devices. The electric field in most cases is heterogeneous and very complex in its structure. Thus, the study of the motion of electrons in inhomogeneous electric fields is very difficult. It belongs to the field of electronics called electronic optics. Many scientific publications have been devoted to the dynamics of the motion of an electron in an electric field alone, but the vast majority of them cover the range of pre-relativistic velocities.

For moving charged bodies in such a range, sufficient accuracy is provided by Coulomb's law of electrical interaction – the basic law of electrostatics, which determines the magnitude and direction of the force of interaction between two stationary point charges. At subrelativistic speeds, Coulomb's law inadmissibly distorts the real process. Therefore, we have to turn to complex equations of the theory of relativity, and not always applicable and which in most cases can not be used in practice.

Restrictions on the immobility of the interacting masses and charges in (1), (2) can be interpreted as the propagation of electric and gravitational fields with infinite velocity, or the so-called instant interaction. In fact, according to modern notions, both electric and magnetic fields propagate with the maximum possible physical velocity c = 3.108 m/s. Therefore, to adapt laws (1), (2) to real conditions, it is enough to consider the time delay of field interaction! Otherwise, at the frozen moment of time t, the distance should not be taken to the real distance of the interacting bodies, but to the interacting point of the trajectory taking into account the time step Δt.

Basic laws of dynamics

There are practical problems that do not satisfy (1) and we have to turn to the incredibly complex equations concerning the distorted Riemannian space-time, which can not always be used. While there are no such problems in electricity since the effects of vortex motion are successfully taken into account under the guise of a magnetic field. Therefore, a reasonable question arises why not express the problems of mechanics through ready-made solutions of electricity. This adaptation was successfully carried out [2]. In the general case of oblique relative motion of the body to the force of the gravitational field, formula (1) takes the form [2]

$$\mathbf{F} = \gamma \frac{m_1 m_2}{R^2}\left(1+\frac{v^2}{c^2}+2\frac{v}{c}\mathbf{v}_0\cdot\mathbf{r}_0\right)\mathbf{r}_0. \quad (3)$$

where v is instantaneous speed; $\mathbf{v}_0$ is the unit velocity vector.

The law (3) has been tested at relativistic velocities in problems of the dynamics of celestial mechanics. In particular, the formula of the gravitational radius is obtained, which coincides with that obtained based on the Schwarzschild metric in the curvilinear Riemannian space, and the dynamics of free gravitational fall on the collapser GRO J0422 + 32 / V518 Per is simulated. Based on electromechanical analogies, we can also write Coulomb's law (2) adapted to moving charges [2]:

$$\mathbf{F} = k \frac{q_1 q_2}{R^2}\left(1+\frac{v^2}{c^2}+2\frac{v}{c}\mathbf{v}_0\cdot\mathbf{r}_0\right)\mathbf{r}_0. \quad (4)$$

Law (4) was also tested at relativistic velocities in problems of electron motion dynamics in a vortex non-uniform vortex electric field [2]. Based on the formal similarity of laws (3), (4), we write them both in a common unified form:

$$\mathbf{F} = k_x \frac{x_1 x_2}{r^2}\left(1+\frac{v^2}{c^2}+2\frac{v}{c}\mathbf{v}_0\cdot\mathbf{r}_0\right)\mathbf{r}_0, \quad x = q, m, \quad (5)$$

where $k_x (x = q, m)$ are the world constants (G, k), moreover, q indicates involvement in electrical quantities, and m in mechanical quantities. The desired orientation of the vectors of space and velocity is found from the corresponding coordinate equations of mechanical motion!

We can show that from formula (5), as a triune symbiosis of the laws of Newton, Coulomb, and our Panta Rhei "everything flows"– there is a description of the movement of the whole (at least at the macro- and mega-level) unique material world. Therefore (5) can be called the proto formula of motion. On its basis, you can unify all known laws of mechanics, based on the laws of electricity. Below we will dwell on some of them concerning the electric and gravitational fields.

Vector of Poynting

We arrive at the Poynting vector in the electric field based on the power balance. Since this is a classical material, we will write the finished expression of the corresponding component of this balance as the flux of radiated power through a given surface S

$$p = \int_S \mathbf{\Pi} d\mathbf{S}, \quad (6)$$

where $\mathbf{\Pi}$ is actually equal to:

$$\mathbf{\Pi}_k = v_{0k}(\mathbf{E}_k \times \mathbf{B}_k), \quad k = q, m, \quad (7)$$

where $\mathbf{B}_k$ is induction as a vortex component of the field; v_{0k} is the reluctance of the siege, and the dimension of the Poynting vector in both cases is the same – kg/s3 (W/m2).

Based on the analogies of electric and mechanical fields, the vector (7) can be written in the usual mechanical notation

$$\mathbf{\Pi}_m = \frac{c^2}{4\pi G}(\mathbf{\Gamma} \times \mathbf{\Omega}), \quad (8)$$

where $\mathbf{\Gamma}$ is the vector of linear acceleration; $\mathbf{\Omega}$ is the angular velocity vector.

Integral (6) presents the power component of the gravitational field that is spent on cosmic radiation.

Lorentz force

At first glance, Lorentz force seems to shift us not to the side of mechanics, but, on the contrary, to the side of magnetism. But whether it is, we will try to understand more meticulously. The law looks like this

$$\mathbf{F} = q_2(\mathbf{E}_q + \mathbf{v} \times \mathbf{B}_q), \quad (9)$$

where $\mathbf{B}_q$ is the vector of magnetic induction; $\mathbf{E}_q$ is a vector of electric field strength by definition:

$$\mathbf{E}_q = k_q \frac{q_1}{r^2} \mathbf{r}_0. \quad (10)$$

Having some experience in the analogy of the basic electrical and mechanical laws (5), we turn to the expression of the Lorentz force (9), which was experimentally obtained for vortex electric fields. It can also be given greater transparency in terms of mechanics as Newton's second law in the vortex field of mutually orthogonal accelerations

$$\mathbf{F} = m_2(\mathbf{\Gamma} + \mathbf{v} \times \mathbf{\Omega}). \quad (11)$$

where $\mathbf{\Gamma}$ is the free-fall acceleration vector, the form of which is similar to (10) :

$$\mathbf{\Gamma} = k_m \frac{m_1}{r^2} \mathbf{r}_0. \quad (12)$$

The first law of gravity

We come to the laws of gravity formally based on (5). Formula (5) enables the principal vectors of electric and mechanical fields to be expressed in the same way as an electric field

$$\mathbf{E}_q = -\frac{\partial \mathbf{A}_q}{\partial t}; \quad \mathbf{B}_q = \nabla \times \mathbf{A}_q, \quad (13)$$

where $\mathbf{A}_q$ is the vector potential of the vortex electric field; $\mathbf{B}_q$ is the vortex electric field induction vector. For this purpose, it is enough to take a vector operation $\nabla \times$ from the first expression, and to substitute the second expression in the received result therefore

$$\nabla \times \mathbf{E}_k = -\frac{\partial \mathbf{B}_k}{\partial t}, \quad k = q, m. \quad (14)$$

In the electric version, formula (10) is known as Maxwell's second law.

In the case of a mechanical field in the usual notation, expression (10), based on the analogies of both fields, will have the form

$$\frac{\partial \mathbf{\Gamma}}{\partial t} = c^2 \nabla \times \mathbf{\Omega}. \quad (15)$$

The second law of gravity

We will interpret the second law of gravitation as an analog of Faraday's experimental law of electric induction (1831), which conditionally initiated the second technical revolution following the patent of the Watt steam engine (1769), which initiated the first of them. For this purpose, it is enough to take a vector operation from the first expression (13) and to substitute the second expression in the received result. Therefore:

$$\nabla \times \mathbf{E}_k = -\frac{\partial \mathbf{B}_k}{\partial t}, \quad k = q, m. \quad (16)$$

In the electric version, formula (16) is known as Maxwell's second law.

In the case of a mechanical field in the usual notation, expression (16), based on the analogies of both fields, will have the form

$$\nabla \times \mathbf{\Gamma} = -\frac{\partial \mathbf{\Omega}}{\partial t}. \quad (17)$$

For certainty, (17) can be arrived at habitually if the vectors of motion are expressed based on the laws of classical mechanics. Having written down the expression of acceleration by definition

$$\mathbf{\Gamma} = \frac{\partial \mathbf{V}}{\partial t}. \quad (18)$$

and taking the vector operation $\nabla \times$ from the left and right parts (13), provided that the angular velocity vector $\mathbf{\Omega}$ is a vortex component of the linear velocity vector $\mathbf{V}$, equation (17) is converted to (16). The sign "-" in (16) is introduced by matching the vector orientation according to the rule of the right screw.

Vector potential equation

The equation of vector-potential A is the basic equation of electricity and gravity. It is easily obtained based on (5) [4]. For electricity, it takes the form

$$\frac{1}{c^2}\frac{\partial^2 \mathbf{A}}{\partial t^2} = \nabla \times (\nabla \times \mathbf{A}). \quad (19)$$

For gravity (17) will be similar

$$\frac{1}{c^2}\frac{\partial^2 \mathbf{v}}{\partial t^2} = \nabla \times (\nabla \times \mathbf{v}). \quad (20)$$

Some laws are considered – only part of the possible similarities, in particular in the field of the vector potential.

Equations (14), (16), (19), (20) describe the whole spectrum of electric and gravitational waves!

Gravitational waves.

On February 11, 2016, the LIGO and VIRGO collaborations announced the experimental discovery of gravitational waves resulting from the merger of two black holes weighing with 36 and 29 solar masses into one with a mass of 62 solars. Thus, the energy released in tenths of a second in the fusion is the equivalent of about 3 masses of the sun. The distance to the source is about 1.3 billion light-years. Gravitational waves were predicted by many theories of gravity. But to detect them, a surprisingly sensitive detector was needed. When such oscillations reach the Earth, they have a very small amplitude – thousands of times smaller than the atomic nucleus.

The existence of gravitational waves can completely change our perception of the universe. It will be possible to look into the most remote corners of the cosmos because such waves propagate in the Universe without hindrance. Due to gravitational waves hope to reveal some of the greatest mysteries in science, such as what makes up a large part of the universe. After all, only 5 % of the universe is ordinary matter, 27 % is dark matter, and the other 68 % is dark energy. They are called dark because they are unknown.

Gravitational waves are emitted by any massive body moving with acceleration. However, an extremely large mass of emitter and / or huge accelerations are required for a wave of significant amplitude to occur. If a certain object moves rapidly, it means that it is affected by some force from another object. In turn, this other object has the opposite effect. It turns out that two objects emit gravitational waves only in pairs. For the solar system, for example, the greatest gravitational radiation is caused by the subsystem of the Sun and Jupiter. The power of this radiation is negligible – about 5 kW. The most powerful sources of gravitational waves are colliding galaxies and the gravitational collapse of a binary system of compact objects with huge accelerations and huge masses.

Electric waves are described by Maxwell's equations (14), (16), which must be supplemented by two continuity equations

$$\nabla \cdot \mathbf{E} = 0; \quad \nabla \cdot \mathbf{B} = 0. \tag{21}$$

providing an unambiguous solution under given initial and boundary conditions.

The equivalents of equation (21) in the gravitational field will be(22)

According to the rules of vector analysis [4] based on equations (15), (17), (22) we obtain the classical equations of gravitational transverse waves

$$\frac{1}{c^2}\frac{\partial^2 \mathbf{U}}{\partial t^2} = \nabla^2 \mathbf{U}, \;\; \mathbf{U} = \mathbf{\Gamma}, \mathbf{\Omega}. \tag{23}$$

Equation (23) is of the vector kind. If necessary, they can be written in different coordinates. In the case of the symmetric spherical wave in spherical coordinates, expression (23) is simplified to the classical

$$\frac{1}{c^2}\frac{\partial^2 U}{\partial t^2} = \frac{\partial^2 U}{\partial r^2}, \quad U = \Gamma, \Omega. , \tag{24}$$

where r is the spatial radius.

The gravitational wave is transverse as is parallel to the electric one described by Maxwell's equation (14), (16). In the void, the vectors of the stationary and vortex components are necessarily perpendicular to the direction of wave propagation. Such properties are unconditionally confirmed by the experiment. Without electric transverse waves, we cannot imagine the existence of civilization. But it never occurs to any of us that they "distort space", "change the structure of space-time", and so on, as relativists so convince us.

3. Dimensions of parallel quantities

Based on the interesting symmetry of the law of dynamics of electricity and gravity (5), we can show that all dimensions of parallel quantities – both vector and integral – of gravitational and electric fields have the same conversion factor $\xi = \text{kg}\,\text{s}^{-1}\text{A}^{-1}\,(\text{kg/C})$.

4. Conflict of Interest

The authors claim that there are no possible financial or other conflicts over the work.

5. Conclusions

1. The laws of Coulomb's electrical interaction and Newton's gravitational interaction are adapted to the case of moving masses, electrical and mechanical, in the range of realistically possible velocities [0, c]. The adaptation was carried out bypassing the theory of relativity in real three-dimensional space and physical time. The finite speed of propagation of electric and gravitational fields is taken into account. It is shown that a constant conversion factor is preserved between the parallel dimensions of both fields.

2. Basing on this adaptation, some mechanical laws of the gravitational field, including the equations of gravitational waves, were obtained by analogy with the corresponding laws of the electric field, the truth of which is duplicated by the methods of classical mechanics.

3. Significant simplification of the analysis of the dynamics of motion of electric and gravitational masses in the corresponding force fields lays the prospects for new opportunities for high-speed metrology in gravity and electrometry,

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