ISSN: 3066-7194
Research Article
Novel Journal of Applied Sciences Research

Unaccounted Energy Aspects of the Gravifrequency and Electromagnetic Interactions with Two Additions

Yevhen Lunin

Independent researchers, Sholom Aleikhema, 23, Kherson, Ukraine

***Corresponding author:** Yevhen Lunin, independent researchers, Sholom Aleikhema, 23, Kherson, Ukraine

Submitted: 04 September 2025 **Accepted:** 10 September 2025 **Published:** 16 September 2025

https://doi.org/10.63620/MKNJASR.2025.1054

Citation: *Lunin, Y. (2025) Unaccounted Energy Aspects of the Gravifrequency and Electromagnetic Interactions. With two Additions, Nov Joun of Appl Sci Res, 2(5), 01-08.*

Abstract

The electric charge definition is formulated. The refined formula of the electric charge non-invariance is given. The electric charge momentum conservation law was obtained. The concept of "the charged particle spin" is clarified. The angular momentum conservation law for electric charge was obtained. The frequency moment definition (the magnetic moment analog) is formulated in gravidynamics. The formula for the ki- netic energy of the translational motion of an electric charge was constructed. Steiner's theorem for electro- dynamics was formulated. The rotational motion dynamics equation was constructed for electric charge. The formula for the kinetic energy of the rotational motion of an electric charge was constructed. A Planck for- mula analog for the magnetic field was obtained. Another kind of uncertainty relation was obtained. Formula for the interval s between two events was constructed in the electric charge space. The author proposes the Coulomb's law application limit explanation. The author assumes the parallel study possibility of black holes and atomic nuclei. An explanation is offered of Kozyrev N.A.'s experiments, which he could not explain. It is shown that force lines of an angular velocity vector are closed, similar to the magnetic force lines. Some facts analyzing possibility of microworld (spin-spin and spin-orbit interactions, Pauli's prohibition principle) in terms of the frequency interactions is offered. A Reynolds number analog for electromagnetism was obtained: $\check{R} = \rho\, e\, v\, D/H = I\, D/(s\, H) = 4I/(\pi\, D\, H)$. The experiments results on finding the Reynolds num- ber in electrodynamics are given.

Keywords: The Angular Momentum of Electric Charge, the Rotational Motion Dynamics Equation for Electric Charge, a Planck Formula for the Magnetic Field, Reynolds Number in Electrodynamics.

Introduction

At the very beginning of the discussion, we will try to define the electric charge. Electric charge is a body ac- celeration measure when only an electric field is applied to the body (it's assumed that the body consists only of an electric charge, that's it hasn't mass).

To unambiguous interpret of the terms used in this work, first of all, the author considers it necessary to make some remarks about terminology. Just as in the electric charges interaction field there are electric, magnetic and electromagnetic fields, in the masses interaction field there are gravitational, frequency (the au- thor suggests using this term) and gravifrequency (again, the author suggests using this term) fields. The term "gravitational field" is used in the conventional sense (field with a strength a, which is the acceleration). The frequency field is the field of the angular velocity ω. Given the physical nature of angular velocity and frequency, the term "angular velocity field" may be replaced with the term "frequency field" for brevity. And the gravifrequency field is the same set of gravitational and frequency fields as the electromagnetic field is the set of electric and magnetic fields. Thus, it would be more accurate to speak of a gravifrequency field equations system but not of the gravitational field equations system, and not of gravitational waves, but of gravifrequency waves.

After Maxwell's electrodynamics united in one theoretical scheme the phenomena of electricity, magnetism and optics on the electromagnetic field concept basis, it was hoped that the field concept should be the foundation of a future unified theory of the physical world (Vizgin, 1985) [1].

Einstein attempted to construct a unified field theory in which gravitational and electromagnetic fields are interpreted as components or manifestations of the same unified field (Isaacson, 2007) [2].

The author believes that there is some set of similar formulas (but not identical) that allows you to de- scribe the phenomena of electrodynamics and gravidynamics. Subsequently, it will probably be possible to add hydrodynamics, thermodynamics, and other sections of physics. But the same structure of these formulas (and the symbols included in them) will imply completely different physical quantities, characteristic of one or another section of physics. This paper shows the formulas commonality of electrodynamics and gravidy- namics.

According to Okun L.B. the simplest variants realizing the idea of grand unification assume that there are no new fundamental forces up to colossal energies of the order of 1015 GeV (Okun, 1981) [3]. This work considers the frequency interaction, which is a new fundamental interaction.

Purpose Objectives

The purpose of this work is to generalize and specify some concepts of electrodynamics and gravidyna- mics, as well as to present the results of experiments to determine of the Reynolds number in electrodyna- mics.

Materials Methods

Electric Charge, Electric Charge Non-invariance, Charged Particle Spin, Frequency Moment

The Lagrange function L for the electric charge e in the electromagnetic field can be written in the form (Panofsky & Phillips, 1963) [4].

$$L=-mc^2\sqrt{1-\frac{v^2}{c^2}}+e(\boldsymbol{A}\cdot\boldsymbol{v})-e\phi \quad (1)$$

Let's transform the Lagrange function for the electric charge space.

By the concept of "electric charge space" the author understands everything that exists or happens with- out the presence of masses. That's all bodies must be of zero mass and processes or phenomena must occur with bodies having zero mass. And in the calculations, it's necessary to take into account only the electric charge of considered bodies. Since in gravifrequency interactions the vector potential

Ag = v, (Lunin, 2024) [5] and v = a×t, then in electric charge space

$\boldsymbol{A}_e = \boldsymbol{E}\times t,$

where E is electric field strength.

And when the vector potential Ae is multiplied by the electric charge e, the formula for the electric charge momentum pe is formed.

$p_e = e\boldsymbol{A}_e$

It should be noted that p_e is not a part of the fictitious momentum P, as indicated in the work (Chubykalo et al.,2020) [6], but of the real one. There is no fiction here. The electric charge momentum pe is a part of the ge- neralised momentum P, which is equal to the sum of the mechanical momentum (mv) and of the electric charge momentum (p_e). And hence, there is no forgery or falsification here.

In work (Chubykalo et al., 2019) [7] it is stated: Newton's law of world gravitation has not yet had an elec- tromagnetic explanation. It should be noted that it and cannot receive an electromagnetic explanation. Our knowledge of mass and electric charge go parallel streets. The kind of laws on one street coincide with the kind of laws on the other street. But the basis on each street is different, on one street it is mass and on the other street it is electric charge. Therefore, it is incorrect to explain any effects of gravitation (not only the Newton's law of world gravitation with the help of electric charge). How can a tomato salad have a cucumber explanation? Of course, the relationship between mass and electric charge can always be found, and in different aspects. But it is impossible to explain mass through electric charge and vice versa. Gravifrequency phenomena are explained by the presence and motion of masses, and electromagnetic phenomena are explained by the pre- sence and motion of electric charges.

For the electric charge space (given that E = λe (Lunin, 2006) [8] and c2 ↔ λ (Lunin, 2022) [9] the Lagrange function will be in the form

$$L_e=-e\lambda\sqrt{1-\frac{\boldsymbol{E}t\boldsymbol{v}}{\lambda}}+e(\boldsymbol{A}_e\cdot\boldsymbol{v})-e\phi_e \quad (2)$$

where λ is constant (λ ≈ 106 V) (Lunin, 2006) [8];

ϕe is electric field potential.

The refined formula of electric charge non-invariance was applied in formula (2) (Lunin, 2006) [8].

$$e=\frac{e_0}{\sqrt{1-\frac{\boldsymbol{E}t\boldsymbol{v}}{\lambda}}}$$

Then the action S_e for an electric charge in an electromagnetic field can be written as follows

$$S_e=\int_{t_1}^{t_2}\left(-e\lambda\sqrt{1-\frac{\boldsymbol{E}t\boldsymbol{v}}{\lambda}}+e(\boldsymbol{A}_e\boldsymbol{v})-e\phi_e\right)dt$$

Similarly, formula (1) can be transformed into a Lagrange function for the mass m in the gravifrequency field

$$L_g = -mc^2\sqrt{1-\frac{v^2}{c^2}} + m(\mathbf{A}_g \cdot \mathbf{v}) - m\phi_g \ ,$$

where ϕ_g is the gravitational field potential.

Then the action S_g for mass m in the gravifrequency field can be written as follows

$$S_g = \int_{t_1}^{t_2} \left(-mc^2\sqrt{1-\frac{v^2}{c^2}} + m(\mathbf{A}_g \mathbf{v}) - m\phi_g\right) dt \ .$$

Formulas (3) and (4) for the action (Landau & Lifshits, 1969) can be converted to formulas (3a) and (4a) for the gravifrequency field

$$S_e = \int_{t_1}^{t_2} -mc^2\sqrt{1-\frac{v^2}{c^2}}\, dt - \int_a^b \frac{e}{c} A_\mu dx^\mu \qquad (3)$$

$$S_{e1} = -\Sigma \int mc\, ds - \Sigma \int \frac{e}{c} A_\mu dx^\mu - \frac{1}{16\pi c} \int F_{\mu\nu} F^{\mu\nu} d\Omega \qquad (4)$$

$$S_g = \int_{t_1}^{t_2} -mc^2\sqrt{1-\frac{v^2}{c^2}}\, dt - \int_a^b \frac{m}{c} A_\mu dx^\mu \qquad (3a)$$

$$S_{g1} = -\Sigma \int mc\, ds - \Sigma \int \frac{m}{c} A_\mu dx^\mu - \frac{1}{16\pi c} \int F_{\mu\nu} F^{\mu\nu} d\Omega \qquad (4a)$$

In formulas (3a) and (4a) the expressions A_μ and $F_{\mu\nu}$ should be understood as vector potential and tensor of the gravifrequency field.

From formulas (3a) and (4a), following the proof scheme given in (Landau & Lifshits, 1969), one can obtain a gravifrequency field equations system. This was done by the author in (Lunin, 2024) [5]. If we want to go to the "pure" space of electric charge, then in formulas (3) and (4) the first terms should be changed and written in this form

Unaccounted Aspects Two

$$\int_{t_1}^{t_2} \left(-e\lambda\sqrt{1-\frac{\mathbf{E}t\mathbf{v}}{\lambda}}\right) dt \quad \text{and} \quad \Sigma\int_{t_1}^{t_2} \left(-e\lambda\sqrt{1-\frac{\mathbf{E}t\mathbf{v}}{\lambda}}\right) dt$$

Let's write the expression for the electric charge momentum p_e located in a constant electric field with a strength E = (Ex , 0, 0). Notice the body is in the electric charge space.

$p_e = e\,Et$,

where it is the existence time of the body in the electric field. There is the electric field only.

d p_e

Then we can write an expression for the force

where $F_e = e\,E$.

dt = F_e

In the absence of external forces ($F_e = 0$) we can write

d p_e

dt = 0

Consequently it's possible to formulate the electric charge momentum conservation law: the electric charge momentum (located in a system of electric charges) is constant for a closed system.

It should be noted that the electron spin needs to be specified. The electron has mass and electric charge. Each of these quantities is responsible for its part (its contribution) to the total spin. And since both parts are measured in the same units (J·s), they appear as one common spin.

This remark about spin applies to all particles that have mass and electric charge.

The same can be said about the orbital momentum (mechanical and electric) of objects that have mass and electric charge. The total momentum will consist of the sum of the mechanical momentum (mv) and the electric charge momentum (eEt).

Let's compare the expressions for the momentum of the electron as the possessor of mass and as the pos- sessor of electric charge (Lunin, 2024) [5].

mv/(eEt)(5)

Given that v = at, we can rewrite the previous expression as mat/(eEt) = ma/(eE)

In the right part of the equation we see the relation of two forces: centripetal and Coulomb forces. In the problem under consideration, they are equal when moving in a circle. So the relation (5) is equal to 1. Conse- quently, the mechanical momentum is equal to the electric momentum.

Then, comparing mechanical kinetic energy ($mv^2/2$) and electric kinetic energy (eEtv/2) we can see that they are equal. This statement is more true than in previous works.

By analogy with mechanics let's write the expression for the point electric charge e angular momentum

Le (in the electric charge space) relatively to the point O as a vector product

Le = [r × p_e],

where r is the radius-vector from point O to the point charge e.

Le = e [r × E] t

d Le

d t = [r × $\boldsymbol{F}_e$]

d Le

d t = Me,

And we got the expression for the forces moment Me relatively to the same point O.

Consequently it's possible to formulate the angular momentum conservation law for electric charge: the electric charge angular momentum Le is constant for a closed system (that's $\boldsymbol{M}_e = 0$).

Let's find a physical quantity that is the magnetic moment analog $\boldsymbol{p}_m$.

Let's write down the formula for the magnetic moment $\boldsymbol{p}_m$

$\boldsymbol{p}_m = I S \boldsymbol{n}$,

where I is electric current; S is the contour area;

n is unit vector of the normal to the area S.

By analogy with the electric charge space, let's call the next expression the frequency moment pω

$\boldsymbol{p}_{\omega} = I_{mas}\ S\ \boldsymbol{n}$,

where I_{ma} is mass current flowing along the circuit;
S is the area covered by this contour.
The mass current Imas should be understood as the consumption Q_{mas} of mass m, that's the mass m change per unit time t

$I_{mas} = Q_{mas} = \Delta m/\Delta t$

Kinetic Energy and Steiner Theorem for Electric Charge

By analogy with mechanics we can write an expression for the kinetic energy Ek of an electric charge $e\ E_{ke} = e \times \boldsymbol{E} \times t \times \boldsymbol{v}\ /2$ (understanding that E×t is an analog of a×t = v)

We can write a general expression for the kinetic energy $E_k = \boldsymbol{pv}/2$

If the body has both mass and electric charge, the total kinetic energy will be as follows

$E_k = E_{kg} + E_{ke} = \boldsymbol{p}_g \boldsymbol{v}/2 + \boldsymbol{p}_e \boldsymbol{v}/2 = m\boldsymbol{vv}/2 + e\boldsymbol{E}t\boldsymbol{v}/2 = (m\boldsymbol{v} + e\boldsymbol{E}t)\boldsymbol{v}/2 = \boldsymbol{pv}/2$

And not only mass, but also the electric charge of the body (particle) is responsible for the amount of energy in the body (particle). And when calculation the total energy Etot of a body (particle) it will be neces- sary to take into account the formula (Lunin, 2006) [8].

E = eλ

By analogy with mechanics we define the electric charge e inertia moment Ie relatively to a given axis as the value equal to the product of the electric charge e and the distance r square to the considered axis

$I_e = e\ r^2$

It's possible to formulate the Steiner theorem analog (for electric charge). The electric charge e inertia moment Ie relatively to an arbitrary axis is equal to its moment Ic of inertia relatively to a parallel axis passing through the electric charge center C added with the product of the electric charge e and the distance a square between the axes

In mechanics

Ie = Ic + e a2

L = I ω,

where L is the angular momentum;
I is the inertia moment;
ω is the angular velocity.

Passing to the electric charge space, we replace ω by the magnetic induction B/2 (Lunin, 2024) [5]. By analogy we can write

$\boldsymbol{L}_e = I_e\ \boldsymbol{B}/2$

where $\boldsymbol{L}_e$ is the angular momentum of the electric charge.
It's possible to construct the rotational motion dynamics equation of electric charge e relatively to a fixed axis.
In mechanics (Hajkin, 1947) [10].

$$\boldsymbol{M} = I\ \frac{d\,\omega}{d\,t}\ ,$$

where M is the force moment.

Passing to the electric charge space, we can write the rotational motion dynamics equation of electric charge

$$\boldsymbol{M}_e = \frac{1}{2}\ I_e\ \frac{d\,\boldsymbol{B}}{d\,t}\ ,$$

where $\boldsymbol{M}_e = [\boldsymbol{r} \times \boldsymbol{F}_e] = [\boldsymbol{r} \times (e\,\boldsymbol{E} + e\ \boldsymbol{v}\ \boldsymbol{B})]$

It's possible to construct a formula for the kinetic energy of the rotational motion in the electric charge space.

As it's known, the kinetic energy of the rotational motion in mechanics is calculated by the formula

$E_k = I\ \omega^2/2$

By analogy let's write down the formula for the kinetic energy Eke of the rotational motion in electric charge space. In the last formula we replace ω by B/2 (but only for one ω). Then

$E_{ke} = I_e\,\boldsymbol{\omega} \cdot \boldsymbol{B}\ /4$

Planck Formula, Interval, Uncertainty Relation

In the electric charge space it's possible to construct the Planck formula analog, in which the mag- netic induction B will participate together with some constant. Let's write down the Planck formula

$E = \hbar\ \boldsymbol{\omega}$

Let's replace ω with the magnetic induction B. In this case, it will be necessary to replace and ħ with some other constant

$E = const \cdot B/2$

From this it can be seen that if ħ represents a certain value of the angular momentum in the Planck for- mula, then the constant represents a certain (constant) minimum value of the magnetic moment in the last for- mula. Let's denote it by $\boldsymbol{p}_{m0}$. It's highly likely that it will be the nuclear magneton. Then

$E = \boldsymbol{p}_{m0} \cdot \boldsymbol{B}$

This is the Planck formula analog.

There is a formula for the interval s between two events (Trofimova, 2006) [11].

$s^2 = c^2\ t^2 - x^2 - y^2 - z^2$

Let's construct this formula analog in the electric charge space. c2 will be replaced by λ. In the expression t2 we pass to angular velocity (t = 2π/ω). And we will do it only for one time, and leave the second time t unchanged. In the right-hand side of the equation, the first term will look like this λ t 2π / ω.

And now we replace ω by B/2. And we get the final formula for the interval se between two events in the electric charge space

$s^2 = \lambda\ t\,(4\pi/B) - x^2 - y^2 - z^2$

De Broglie wavelength λB = h/p (Trofimova, 2006) [11]. In the electric charge space it will look as follows

$\lambda_{Be} = h/(eEt)\ \lambda_{Be}/(2\pi) = \hbar/(eEt)\ 1/k_e = \hbar/(eEt)\ eEt = \hbar\ k_e$

$p_e = ħ k_e$

Let's write the uncertainty ratio (Trofimova, 2006) [11].

$\Delta E \times \Delta t \geq ħ$

Considering that (Lunin, 2006) we can write

$E = e\lambda$,

$\Delta(e\lambda) \times \Delta t \geq ħ$

$\Delta e \times \Delta t \geq ħ/\lambda$

The shorter some state existence time or the time allotted for its observation, the less definitively it's possible to speak about the electric charge of this state.

Let's think about the uncertainty ratio from a different point of view. Based on the three conservation laws (angular momentum, energy and momentum), we can formulate three postulates.

a) Postulate 1: there is a minimum value of angular momentum (it turned out to be equal to ħ). This immediately follows the Heisenberg uncertainty ratio.

$r \times p \geq ħ$

Or in a more familiar form

$\Delta r\, \Delta p \geq ħ$ (6)

We obtained the known uncertainty relation, but only did it in a simpler way (by introducing postulate 1). Of- course, you need to understand that pg and pe are calculated using different formulas (see above).

B) Postulate 2: there is a minimum value of energy. Let's denote E_{min} - the minimum energy value.

If ħ is a constant value, then there is a minimum value ωmin

$E \geq ħ\,\omega_{min}$ $E/\omega_{min} \geq ħ$

Or in a more familiar form

$\Delta E\, \Delta t \geq ħ$ (7)

The last expression can be obtained without the second postulate.

If p = E /c, then we can divide and multiply the left-hand side of expression (6) by c and obtain the expression (7).

a) Postulate 3: there is a minimum value of momentum.

$p \geq p$ min

If p = E /c, then $p \geq$ Emin /c $p \geq ħ$ ωmin /c p /ωmin $\geq ħ$ /c

$\Delta p\, \Delta t \geq ħ/c$ (8)

The last expression can be obtained without the third postulate. We can divide expression (6) (7) by c (or di- vide expression (6) by c) and obtain the expression (8).

Note that it's not necessary to formulate all three postulates to obtain expressions (6) – (8). It's enough to formulate any of the three postulates and hence all three expressions (6) – (8) are obtained.

Interactions Comparison

This part gives a comparative analysis of different interaction forces (electric with gravitational, magne- tic with frequency, electromagnetic with gravifrequency). As well in this section the formula of the constant characterizing gravifrequency interactions is constructed.

The ratio of the electric interaction force to the gravitational interaction force is calculated trivially in a school physics course.

$$\frac{F_{el}}{F_{gr}} = \frac{e^2}{m^2 4\pi\varepsilon_0 G} = 4.17 \times 10^{42} \quad (9)$$

where e and m are the electric charge and mass of electron; ε_0 and G are electric and gravitational constants.

A value of the same order is also given in (Wilczek, 2017) [1].

It should be noted that so far we can speak about the relation only of electric and gravitational forces, but not about the relation of electromagnetic and gravifrequency forces. Although in the future it will turn out that this relation is true for electromagnetic and gravifrequency interaction as well.

Let's try to calculate the ratio of magnetic forces to frequency forces. The interaction force between two magnets placed in parallel is calculated by the formula (Pyatin, 1980) [12].

$$F_{mag\ par} = \frac{0.75\,\mu_0 p_1 p_2}{\pi r^4} \quad (9a)$$

where p1 and p2 are magnetic moments; r is the distance between the magnets.

Let's calculate this force of interaction between two elementary magnets. As elementary magnets, let's take two electrons rotating along different circuits (S1 and S2) and with different rotation periods (T1 and T2)

$$F_{mag\ par} = \frac{0.75\,\mu_0 \frac{e}{T_1} S_1 \frac{e}{T_2} S_2}{\pi r^4}$$

For the electron, as a mass carrier, we can write by analogy the formula for the frequency interaction force

$$F_{\omega\ par} = \frac{0.75\,\mu_{0g} p_{\omega 1} p_{\omega 2}}{\pi r^4}$$

$$F_{\omega\ par} = \frac{0.75\,\mu_{0g} \frac{m}{T_1} S_1 \frac{m}{T_2} S_2}{\pi r^4}$$

$$\frac{F_{mag\ par}}{F_{\omega\ par}} = \frac{\mu_0 e^2}{\mu_{0g} m^2} \quad (10)$$

$\mu_{0g} = 4\pi G/c^2$ (Lunin, 2024).

Then $\frac{F_{mag\ par}}{F_{\omega\ par}} = \frac{\mu_0 e^2 c^2}{4\pi G m^2}$

$$\frac{F_{mag\ par}}{F_{\omega par}} = \frac{e^2}{m^2 4\pi\varepsilon_0 G} = 4.17 \times 10^{42}$$

We obtained an expression (10) that coincides completely with expression (9).

And only now we can assert that expression (8) characterises the relation not only of electric interaction to gravitational interaction or magnetic interaction to frequency interaction; expression (9) characterises the relation of electromagnetic interaction to gravifrequency interaction.

Comparison of the Schwarzschild Radius and its Analog for Electric Charge

The formula for the Schwarzschild radius analog in case of a static spherically symmetric electric charge was obtained in (Lunin, 2022) [9].

$$r_\lambda = \frac{e}{4\pi\varepsilon_0\lambda}$$

where λ is constant ($\lambda \approx 10^6$ V) (Lunin, 2006) [8]

Let's calculate the Schwarzschild radius rλe analog for a proton/electron/positron having an almost ele- mentary electric charge.

$r_{\lambda e} = 1.44\times10^{-15}$ m $\approx$ 10^{-15} m

We got the Schwarzschild radius rλe analog for the proton/electron/positron. And the atomic nuclei di- mensions are just of such order (about 10-15 m) (Safarov, 2008) [11]. We can say that the protons in the nucleus are in black hole conditions, that is, every atomic nucleus is a black hole. And for each atomic nucleus there will be a different value of the Schwarzschild radius analog, depending on the nucleus charge. At this dis- tance, the Coulomb's repulsion of protons in the nucleus no longer prevents them from approaching, and a strong interaction begins to appear.

It turns out that it is precisely at distances of this order the Coulomb's force becomes vanishingly small, either by itself or in comparison with the forces of another nature manifested at such distances. It's well known that the deviations from the Coulomb's law occur at distances of this order. In other words, calculat - ing the Schwarzschild radius analog for the proton/electron/positron, we see that this radius coincides with the Coulomb's law application limit.

And although the nucleus is limited by the Schwarzschild radius, science has been able to 'break off' pieces of the nucleus. Drawing an analogy with black holes in the Universe, we can expect that it will be possible to 'tear off' pieces from black holes in the Universe. But for this purpose it will be necessary more 'sharp and powerful knife'. The study of black holes in the Universe can help in the study of atomic nuclei and vice versa, and in quite different aspects.

Comparing the gravitational radius value for electron (rge ≈ 10-57 m, this is a tabular value) and the Schwarzschild radius analog value for electron (rλe ≈ 10-15 m), we see that the black hole formation conditions for electron as an electric charge occur at much greater distances than for electron as the mass owner. Mod - ern science denies the long-lived charged black holes existence possibility, believing that charges of the same sign will quickly scatter in different directions. However, it has to remember that under the black hole conditions, the Coulomb's repulsion forces become vanishingly small (a complete analogy with protons in a nucleus). Therefore, the charge in a black hole can persist for an arbitrarily long time.

A Kozyrev N.A. Experiments Explanation

In (Lunin, 2024) it is shown that $\oint \boldsymbol{\omega}\, d\boldsymbol{s} = 0$

That is, force lines of an angular velocity vector are closed, similar to the magnetic force lines.

Let's try to explain the not completely identical results of the Kozyrev N.A. experiments. According to (Kozyrev, 1991), experiments on the rotating gyroscope weight changing in the north, near Murmansk, al- ways went better than in the Crimea. This he couldn't explain.

In this case, the author proposes to take into account the frequency fields interaction of the rotating gyroscope and the Earth. And then everything becomes clear. The force lines density (or saturation or inten- sity) of the Earth's angular velocity will increase as one moves from the equator to the pole. Therefore, the interaction (attraction or repulsion of the Earth and the gyroscope) between the angular velocities of the gyro- scope and the Earth will be the stronger the closer the gyroscope is to the Earth's rotation axis. That's, the further away from the Earth's equator and closer to its pole (either north or south) a gyroscope is located, the more effective the interaction between the frequency fields of the gyroscope and the Earth will be. The maxi- mum interaction (optimal experimental conditions) of the frequency moments of the Earth and the gyroscope will be at their parallel location, that's at any of the Earth poles. The frequency interaction at the equator will be zero. This is confirmed by the Kozyrev N.A. experiments.

In the first approximation the frequency interaction force between the gyroscope and the Earth can be cal- culated similarly to the interaction force between two permanent ring magnets (Pyatin, 1980) [12].

$$\boldsymbol{F} = \frac{3\mu_{0g}[\boldsymbol{p}_1 \times \boldsymbol{p}_2]}{2\pi z^4}$$

where p1, p2 are the frequency moments of the gyroscope and Earth;

z is the distance between the Earth equator plane and the gyroscope.

Kozyrev N.A. couldn't also explain the difference in the above experiments results, conducted at the same latitude, but at different times of the year (winter, spring, summer and autumn). But if we take into account the position of our planet in its orbit, then it's clear that this difference must be. And it's due to the different interaction of the frequency fields of the gyroscope and the total frequency field of celes- tial bodies (except for the Earth, since the experiments were carried out at the same latitude).

In the author's opinion, the dependence will be on the time of day. Considering the interaction between the frequency fields of the gyroscope and the Sun (and other celestial bodies), one can try to explain the dif- ference in this series of experiments as well. Firstly, at each instant of time the gyroscope position will be characterized by different value of the angular velocity vector of the celestial bodies. And secondly, the angle between the angular velocity vector of the gyroscope and the resulting angular velocity vector of celestial bodies will vary throughout the day. Consequently, the interaction result between the gyroscope and other bodies will also be different, and, therefore, the gyroscope weight will change during the day.

And if this change is confirmed experimentally, it would be another confirmation of the theory presented by the author.

The N.A. Kozyrev experiments with a gyroscope and a thermos, with a gyroscope and the sugar dissolu- tion in a glass with water (Lazarev, 1979) show the effect of such parameter as the internal friction coeffi- cient. According to Kozyrev N.A., the time release (the author understands it as gravifrequency interaction) occurs only during irreversible processes, that's where the system hasn't yet come to equilibrium. And the internal friction coefficient manifestation is especially noticeable where the system hasn't come into equilib- rium or where there is movement of one mass substance relative to another (at their contact, contacting).

Reynolds Number in Electrodynamics

Let's construct the Reynolds number Ř in electrodynamics. Reynolds number R is calculated by the formula (Feynman et al., 1977) [13].

$$R = \frac{\rho v D}{\eta}$$

We replace the dynamic viscosity η by the magnetic field strength H (Lunin, 2024) [5].

Then $$\check{R} = \frac{\rho e v D}{H}$$

The current I in a conductor with cross-section s can be calculated by the formula (Trofimova, 2006) [11].

$I = \rho_e v s$,

where ρ_e = electric charge density;

$s = \pi D^2/4$ (for a circular conductor).

Consequently $\rho_e v = I/s$

Then there is the final expression

$$\check{R} = \frac{\rho e v D}{H} = \frac{I D}{s H} = \frac{4 I}{\pi D H}$$

Having obtained this formula we can proceed to the experimental part.

Changing the magnetic field strength H, we will receive corresponding values of current I, which will be shown by an ammeter in a conductor circuit. And from these values of the magnetic field strength H and the current I we can calculate the Reynolds number in electrodynamics.

The solenoid was made of the ferromagnetic wire with a length of l = 1.1 m and a diameter of D = 0.2 mm.

The wire was wound on a plastic tube with a diameter D = 50 mm. The Reynolds number Ř values change from 1.27×10-3 to 2.54×10-3 when the current I changes from 80 mA to 160 mA with the external magnetic field strength H = 400 A/m. Measurements were taken at 5 mA intervals. The Reynolds number varied in proportion to the current.

The current I change was stably observed at the external magnetic field strength H change from
400 A/m to 103 A/m. The current change was spasmodic, no large and very stable: from 90.2 mA to 90.1 mA (when the external magnetic field strength H reached the value of 700 A/m). A spasmodic change in resis- tance occurs approximately at Ř ≈ 1.43×10-3. The current changes remained the same when the magnetic field direction changed to the opposite.

The same change in current I (by 0.1 mA) is observed at such currents: 80 mA, 100 mA, 130 mA, 150 mA.
The magnetic field strength H change didn't lead to a current change at such currents: 60 Ma, 50 mA or less. Perhaps this is due to the insufficient accuracy of the measuring equipment. The magnetic field strength H change also didn't lead to a current I change at such currents: from 200 mA to 500 mA.

The magnetic field strength H change did not lead to a current I change in experiments with a copper wire with the diameter D = 0.2 mm. The external magnetic field strength H changed so: from 400 A/m up to
1000 A/m. The experiment was carried out in the current range (20÷500) mA.

Results

- the momentum conservation law and the angular momentum conservation law are formulated for electric charge;
- the concept of "the charged particle spin" is clarified;
- Steiner's theorem for electrodynamics was formulated;
- the rotational motion dynamics equation was constructed for electric charge;
- the Planck formula analog was obtained for the magnetic field;
- formula for the interval s between two events was constructed in the electric charge space;
- a Kozyrev N.A. experiments explanation is given;
- the Reynolds number analog values were experimentally obtained in the current range from 20 mA to 500 mA.

Conclusions

It's desirable to carry out further experiments in this direction with more stable and powerful power sources, with more accurate measuring equipment, with different wire diameters and knowing the magnetic permeability μ of the wire.

Funding

This research received no external funding.

Data Availability Statement

Data are contained within the article and collected from the references listed in the bibliography.

Acknowledgments

I express my great gratitude to Eduardo Garcia Parada from Vigo, Spain, where the first experimental results were obtained in a university laboratory.The author is grateful to Tetiana Shashkova, Tatyana Vasina, Vanesa Gonzalez, Oleh Araslanov, Petro Kanivets, Igor Mizin, Kirill Bileckiy and Vladimir Dzjuba for their help. I would like to give special thanks to my grandson

Yaroslav Arnaut, with whom we started a series of experi- ments in 2006 at home.

References

1. Vizgin, V. P. (1985). Unified field theories in the first third of the twentieth century (1st ed.). Nauka.
2. Wilczek, F. (2017). Subtle physics: Mass, ether and the unification of universal forces. Piter.
3. Isaacson, W. (2007). Einstein: His life and universe. Simon & Schuster.
4. Landau, L. D., & Lifshits, E. M. (1969). Mechanics. Electrodynamics. Nauka 3(3), 1-7.
5. Okun, L. B. (1981). Modern state and prospects of high energy physics. Advances in Physical Sciences, 134(1), 23.
6. Panofsky, W., & Phillips, M. (1963). Classical electricity and magnetism. Physmatgiz.
7. Lunin, Y. (2024, April). a gravifrequency field equations system. In APS April Meeting Abstracts (Vol. 2024, pp. KK02-009).
8. Chubykalo, A., Espinoza, A., Kuligin, V., & Korneva, M. (2020). Once again about the problem "4/3". International Journal of Engineering Technologies and Management Research, 6(6), 178–196. https://doi.org/10.29121/ijetmr.v6.i6.2019.407
9. Chubykalo, A., Espinoza, A., & Kuligin, V. (2019). The postulate of equivalence masses of the law of their proportionality? Journal of Physics and Astronomy, 7(2), 1–13.
10. Lunin, Ye. A. (2006). Non-invariance of electric charge and similar substances. Vestnik of Kremenchug State Polytechnic University. Part 2, 2(37), 44–45.
11. Lunin, Y. (2024, June). Schwarzschild radius for electric charge. In APS Division of Atomic, Molecular and Optical Physics Meeting Abstracts (Vol. 2024, pp. B11-005).
12. Lunin, Y. (2025). Reynolds Number in Electrodynamics. J Mat Sci Eng Technol, 3(3), 1-7.
13. Safarov, R. K. (2008). Physics of atomic nuclei and elementary particles. RITS “Shcola”.
14. Trofimova, T. I. (2006). Physics course (11th ed.). Academia.
15. Pyatin, Yu. M. (1980). Permanent magnets (2nd ed.). Energy.
16. Feynman, R., Leighton, R., & Sands, M. (1977). Feynman lectures on physics, Vol. 7: Continuous media physics. Mir.