

Gravity as an Inversion of Electrodynamics in Hypercomplex Space

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Abstract

Gravity is viewed as a conformal mapping of a hypercomplex space onto the space of rotations [1]. It has been shown that gravity represents an inversion of electrodynamics. The inversion of a complex number is written as: $z' = 1/\bar{z} = (1/r)e^{i\varphi}$. Consequently, inversion centered at the origin maps points inside the circle to the outside, and points outside to the inside. The transformation is conformal, i.e., it preserves the angles between curves. From the perspective of electrodynamics (representing the microworld) and gravity (representing the macroworld), inversion maps the microworld onto the macroworld and vice versa. It is shown that the Coulomb constant is the inverse of the gravitational constant, $k = 1/G$. Accordingly, the gravitational permittivity ϵ_g associated with potential field strength is the inverse of the dielectric permittivity ($\epsilon_0 = 1/\epsilon_g$), while magnetic permeability is the inverse of kinetic permeability ($\mu_0 = 1/\mu_g$). The speed of a body with a given mass is also calculated using potential and kinetic permeabilities at a distance of 1 m, yielding a value of $v_g = 1/\sqrt{\epsilon_g \mu_g} = 1/c = \sqrt{\epsilon_0 \mu_0} = 3.336 \cdot 10^{-9}$ m/s. The speed of bodies with mass is inversely related to the speed of light.

Coulomb's and Newton's laws calculate the forces of interaction between charges and masses. Given equal forces at the same distance, formulas have been derived for calculating masses equivalent to charges, and vice versa. Using these formulas, Coulomb's law is expressed in terms of masses, and Newton's law in terms of charges. Similarly, electric field strengths are expressed in terms of equivalent masses, and potentials in terms of equivalent charges. It is shown that the electric capacitance density is equal to the gravitational constant, while the potential capacitance density of a body with mass is equal to the Coulomb constant. The kinetic inductance of mass is inversely proportional to the magnetic permeability of space.

The instantaneous nature of induction arises because, under conformal mapping, spatial coordinates become imaginary—representing rotational frequencies with mirror reflection (i.e., the real and imaginary spectra of the motion trajectory, analogous to a Fourier transform). As a result, a mirror image of the masses is formed, which acts as self-inductance to compensate for trajectory deviations.

As an example, the Earth's orbital speed was calculated using the derived formulas. The agreement between calculated and measured results demonstrated a gravity-electrodynamics inversion in hypercomplex space.

Keywords: Electrodynamics, Gravity, Newton's Law, Coulomb's Law, Hypercomplex Numbers, Conformal Mapping

1. Introduction

Gravity became a science after Newton formulated his law of the attraction of masses in 1687. Until now, there had been only observations and recording of planetary motion. Based on Brahe's observations, Kepler formulated three empirical rules which, in essence, are not laws, although they are commonly referred to as such. Newton's law was consistent with the rules derived by Kepler, although Newton

himself stated that he did not understand why masses attract each other and orbit. In 1798, Cavendish conducted an experiment involving the attraction between lead spheres and thereby measured the gravitational constant. In 1785, Coulomb's law was published, marking the beginning of the development of the theory of electromagnetism. In 1865, Maxwell formulated a unified system of electrodynamic equations based on the experiments of Faraday, Ampère, Coulomb, and Gauss. Although Coulomb's law superficially resembled Newton's law, no connection between them was established, nor was any analogy found between electrodynamics and gravitation. At the same time, Maxwell linked the speed of light to the electric and magnetic permeabilities of the medium and deduced that light is an electromagnetic wave.

In 1893, in his book «Gravitational and Electromagnetic Analogy», Heaviside noted the possibility of an analogy between electromagnetic and gravitational fields and proposed gravitational equations analogous in form to Maxwell's equations. Heaviside introduced magnetic charges and magnetic currents into electrodynamics. The connection between gravity and electrodynamics was demonstrated by Rutherford in the 1911 planetary model of the atom. However, Bohr discovered alleged errors in this model. According to the laws of physics, an electron orbiting the nucleus with acceleration should continuously emit electromagnetic waves and fall into the positively charged nucleus. However, real atoms are stable and exist indefinitely, just like the planets orbiting the Sun. In his book «Causality, Electromagnetic Induction, and Gravitation», the American scientist O. D. Jefimenko continued research aimed at establishing an analogy between electromagnetic and gravitational fields. The necessity for the existence of a cogravitational field, analogous to the magnetic field in electromagnetism, is demonstrated. Newtonian gravitation theory has been generalized to time-dependent systems, resulting in an explanation of gravitational braking forces and Coriolis-like gravitational forces. Einstein developed the general theory of relativity (GTR) in 1915, in which he described how planets orbit stars—specifically the Sun—due to the curvature of space caused by the mass of the stars. The basis for these conclusions was the "Principle of Equivalence" he formulated, which asserts that the effects of gravity and uniform acceleration are locally indistinguishable from one another. However, one cannot judge global difference based on local similarity. As is well known, motion under gravity is circular, whereas uniformly accelerated motion is considered along a straight line.

Recently, the question of the speed of energy transmission over long distances within the Solar System and the universe as a whole has been widely discussed in gravitational theory. It takes 8 minutes and 20 seconds for sunlight to travel from the surface of the Sun to Earth. In the universe, light can travel for tens or hundreds of light-years. This raises questions as to how the rotation of planets and stars is regulated and how the law of conservation of energy is satisfied. In general relativity, the law of conservation of energy holds strictly locally in any small neighborhood. A model of gravity in hypercomplex space has been proposed as an extension of existing theories of gravity [1]. Under a conformal mapping of a hypercomplex space, rectilinear motions are mapped to circular ones. Accordingly, the planet and the Sun form an oscillatory system with capacitance and inductance, which, as is known, possess impedance expressed as complex numbers. All the planets of the solar system create a multitude of oscillatory systems with a frequency spectrum. Oscillatory systems in 2D space are described by complex numbers whose real part represents a scalar corresponding to potential energy, while the imaginary part corresponds to the rotation of a material body in the plane and represents kinetic energy. These quantities cannot be formally added and describe a joint effect in terms of various dual parameters. In 3D space, a conformal mapping is performed onto three imaginary coordinate axes i, j, k and one scalar axis. A scalar can be positioned anywhere in the hypercomplex space, for example, at the point of intersection of the three imaginary parts. At this point, vector addition yields a resultant vector with a norm equal to the scalar part of the quaternion.

In this case, it is necessary to consider hypercomplex numbers; for three imaginary axes, this corresponds to a quaternion in 4D space. Hypercomplex numbers can have a dimension of $N = 2^n$, where $n = 1, 2, \dots$. It is shown that an octonion can be represented as four quaternions in 8D space and that a Maxwell-like equation can be written for it [2,3]. From this, one can conclude that the entire space, despite an increase in its dimensionality, will locally appear to be 3D space. However, it will be characterized by a multiple-input multiple-output (MIMO) relationship. Another important property of hypercomplex numbers is their analyticity (the existence of derivatives of any order) and the satisfaction of the law of conservation of energy through adherence to the Cauchy-Riemann conditions (CRC) [4]. For planets, physically speaking, this means that they move according to harmonic laws—that is, along a circular path. As a planet moves away from the Sun, the potential intensity between them decreases. Consequently, the law of conservation of energy and the CRC require an increase in kinetic intensity, which, in turn, generates potential intensity of the opposite sign in the form of circulation. This phenomenon was discovered by Faraday for charge currents and named "self-induction." A similar mechanism applies to the electron in the Rutherford atomic model. The same self-induction occurs as the planet approaches the Sun; thanks to this, the planet is maintained in its orbit. This phenomenon can be simply described in terms of the capacitance and inductance of space acting as an oscillatory circuit. As is well known, free space has a permittivity ϵ_0 and a permeability μ_0 , which are measured in Farads per meter and Henries per meter, respectively. The Farad characterizes capacitance and the Henry inductance; therefore, free space can also be described in terms of electric capacitance and inductance. The impedances of a capacitor and an inductor are represented by complex numbers.

Since a hypercomplex space is represented by imaginary coordinate axes, that is, by inductances in the context of conformal mapping,

any body within that space corresponds to specific inductance values. As is well known, induction does not depend on the properties of the medium, since it is determined by the product of the permittivity's and the corresponding field strengths i.e., $\mathbf{D} = \epsilon_0 \mathbf{E}$ and $\mathbf{B} = \mu_0 \mathbf{H}$. Consequently, the permeabilities associated with the inductances in a medium with identical permeabilities cancel out mathematically—that is, they compensate for each other. Therefore, inductors act instantaneously.

Instantaneous action is insufficient to stabilize a multidimensional system; a continuous interconnection of elements—of the MIMO type—is required. Such a connection exists and has been proven; it is called "quantum entanglement." Naturally, this does not involve the instantaneous transmission of information, since doing so would require knowledge of the states of all MIMO elements [5,6]. The aim of the article is to show that gravity, under the conformal mapping of a hypercomplex space onto a space of rotations, represents an inversion of electrodynamics.

2. Inversion of the Coulomb and Newton Constants

As is well known, electrodynamics is based on Coulomb's law and Maxwell's equations. In gravitation, Newton's law is primarily used. These laws are similar in form, the only difference being that Coulomb's law involves charges, whereas Newton's law involves the masses of bodies.

Coulomb's law for charges q_1 and q_2 located in a vacuum at a distance r from each other is expressed as:

$$F_k = k \frac{q_1 q_2}{r^2} \text{ N}, \quad (1)$$

where $k=8.988 \cdot 10^9 \text{ N} \cdot \text{m}^2/\text{C}^2$ - electric constant or Coulomb constant.

It is important to note that Coulomb's constant was determined through physical experiment. In the SI system, the Coulomb constant for a vacuum is written as $k = 1/4\pi\epsilon_0$, where $\epsilon_0 = 8.854187817 \times 10^{-12} \text{ F/m}$ is the permittivity of free space (vacuum). As can be seen, Coulomb's constant is derived from the permittivity of free space—that is, it is determined by the properties of space rather than the properties of the charge. The Coulomb constant ϵ_0 is a fundamental quantity that determines the ability of a vacuum to transmit an electric field.

Newton's law for masses m_1 and m_2 in a vacuum, separated by a distance r , takes the form:

$$F_g = G \frac{m_1 m_2}{r^2} \text{ N}, \quad (2)$$

where $\text{N} \cdot \text{m}^2/\text{kg}^2$ is the gravitational constant obtained by Cavendish in experiments with lead spheres.

The force of gravitational interaction is also measured in newtons (N); one newton is equal to the force that accelerates a body with a mass of 1 kg over a period of 1 second, imparting to it an acceleration of 1 m/s^2 in the direction of the force.

It is shown that the gravitational constant can also be expressed in terms of the permittivity $G = 4\pi\epsilon_0 = 1.113 \times 10^{-10}$, with the value measured by Cavendish differing only slightly from the calculated value [1]. In that case, the gravitational constant is the inverse of the Coulomb constant $G = 1/k$, and vice versa $k = 1/G$.

In accordance with (1), the force of interaction between charges is measured in newtons; in accordance with (2), the force of interaction between masses is also measured in newtons. Consequently, these forces can be equated for the same distance r , as $F_k = F_g$ and equations (1) and (2) can be written as an equality:

$$k \frac{q_1 q_2}{r^2} = G \frac{m_1 m_2}{r^2}. \quad (3)$$

Let us consider (3) with equal distances r , equal charge values $q = q_1 = q_2$, and equal masses $m = m_1 = m_2$:

$$kq^2 = Gm^2. \quad (4)$$

Since $G = 1/k$ and $k = 1/G$, we can write (4) as $k^2 q^2 = m^2$ or $q^2 = G^2 m^2$. As a result, we obtain the mass-to-charge ratio $m/q = k$ and the charge-to-mass ratio $q/m = G$. Thus, we have an inversion of the mass-to-charge relationship. Knowing the mass, one can calculate the charge equivalent in strength, and vice versa. For example, for a charge of 1 C, we obtain an equivalent mass of $m = k = 1/G = 8.9875517923(14) \times 10^9 \text{ kg}$. For a mass of 1 kg, we obtain an equivalent charge of $m = e/G = ek = e/4\pi\epsilon_0 = 1.44 \times 10^{-9} \text{ C}$. For the electron charge, we obtain

an equivalent mass of $m = e/G = ek = e/4\pi\epsilon_0 = 1.44 \times 10^{-9}$. The equivalent mass is k times the charge of the electron. The mass of the Earth from the reference source is 5.9726×10^{24} kg. The mass of the Earth is equivalent to a charge of $M_{\text{eth}}/k = 6.645 \times 10^{14}$ C. The large spheres in the Cavendish experiment weighed 49.5 kg, which is equivalent to a charge of 5.508×10^{-9} C. Using the formulas for converting charges to masses, let us express Coulomb's law (1) in terms of the equivalent masses $m_{1,e}$ and $m_{2,e}$:

$$F_{k,m} = k \frac{q_1 q_2}{r^2} = \frac{1}{G} \frac{m_{1,e} G m_{2,e} G}{r^2} = G \frac{m_{1,e} m_{2,e}}{r^2} = \frac{1}{k} \frac{m_{1,e} m_{2,e}}{r^2}. \quad (5)$$

Let us also write Newton's law in terms of equivalent charges $q_{1,e}$ and $q_{2,e}$:

$$F_{g,q} = G \frac{m_1 m_2}{r^2} = \frac{1}{k} \frac{q_{1,e} k q_{2,e} k}{r^2} = k \frac{q_{1,e} q_{2,e}}{r^2} = \frac{1}{G} \frac{q_{1,e} q_{2,e}}{r^2}. \quad (6)$$

As can be seen from (5) and (6), the Coulomb and gravitational constants are inverse with respect to formulas (1) and (2). Thus, since the Coulomb constant is the inverse of the gravitational constant, mass is equivalent—in terms of interaction strength—to a charge determined by multiplying it by the Coulomb constant or by the reciprocal of the gravitational constant. Coulomb's law can be expressed in terms of masses equivalent to charges, and Newton's law in terms of charges equivalent to masses.

3. Inversion of Free-Space Permeabilities

Permittivity of free space (vacuum) $\epsilon_0 = 8.854187817 \times 10^{-12}$ F/m. The quantity ϵ_0 is included in the Coulomb constant $k = 1/4\pi\epsilon_0 = 8.988 \times 10^9$. Judging by the magnitude of Coulomb's constant, it indicates the extent to which the interaction force between two charged particles (or bodies) is amplified for a given ϵ_0 . It should also be noted that π is the number that converts the length of the diameter (a straight line) into the length of the circumference. Moreover, π has an infinite number of digits, which makes it possible to calculate lengths on a vast, cosmic scale with high precision [1]. The permittivity ϵ_0 has a value on the order of 10^{-12} and, consequently, indicates the extent to which the influence of charges on one another is attenuated in the medium. Based on its dimensions, dielectric permittivity can be defined as capacitance density per meter of space. Since the dielectric permittivity is very low, the spatial capacitance density is also low; consequently, the frequency of field-strength oscillations can be very high. It is known that an artificial dielectric—such as the ceramic in a capacitor—reduces the electric field intensity due to dielectric polarization and, consequently, increases the capacitor's capacitance. It is also known that placing a dielectric between the capacitor plates has no effect on the induction.

The Coulomb constant reflects what is ostensibly an intensification of the influence charges exert on one another, and this force is considered a strong interaction. However, k simply corresponds to the measure of charge interaction at very short distances, whereas G represents the interaction of masses at large distances. As the distance decreases, the interaction force increases.

For bodies with mass, let us define the permeability of potential intensity, ϵ_g , as the potential permeability of free space to gravity. The quantity ϵ_g enters into the gravitational $G = 4\pi/\epsilon_g = 4\pi\epsilon_0 = 1.113 \times 10^{-10}$ [1]. Since $G = 1/k$, potential permeability is equal to the reciprocal of the dielectric permeability, that is, it is its inverse:

$$\epsilon_g = \frac{1}{\epsilon_0} = \frac{1}{8.854 \times 10^{-12}} = 1.129 \times 10^{11} \text{ F/m}. \quad (7)$$

The potential permeability ϵ_g (7) is of the order of 10^{11} and, consequently, indicates the extent to which the mutual influence of masses is amplified, for example, the force of attraction according to Newton's law (2). Based on the dimensionality of potential permeability, it can be defined as the density of mass capacity per meter. In gravity, we deal with very large masses located at very great distances. For example, the minimum radius of Earth's orbit is 1.471×10^{11} m. As can be seen from (7), the capacitance density for bodies with mass is very high, at large distances, it increases in proportion to the distance, and consequently, the rotational frequencies of the bodies will be very low.

Thus, an inversion of the medium's dielectric permittivity in electrodynamics and potential permittivity in gravitation occurs: $\epsilon_0 = 1/\epsilon_g$. It should also be noted that the gravitational constant G and the Coulomb constant k do not depend on the charge or mass of the bodies but are determined solely by the parameters of the free medium, ϵ_0 and ϵ_g , which are inverses of each other. Consequently, the quantity G is a measure of the interaction between bodies with large masses at very large distances and is not a weak force. As the distance increases, the force of interaction between charged bodies, as well as between bodies with mass, decreases.

The magnetic permeability of free space is known and equals $\mu_0 = 1.25663706 \times 10^{-6}$ H/m. Based on the dimensions of magnetic permeability it determines the inductance density of space.

Magnetic permeability, like dielectric permittivity, has a low value. The orbital motion of charged bodies generates a magnetic moment through the circulation of electric field intensity. Since charged particles do not propagate through space, the magnetic moment—or magnetic field strength—generated by the transmitting antenna combines with the electric field strength to form an electromagnetic wave, through which energy propagates. In 3D space, circulation can be decomposed into circulations in three planes [7]. According to Maxwell's equations for a quaternion, an electromagnetic wave propagates along a helical trajectory formed by the electric and magnetic field strengths, which are phase-shifted by $\pi/2$ [2].

The dielectric permittivity and magnetic permeability of the medium determine the speed of light in a vacuum $c = 1/\sqrt{\mu_0\epsilon_0} = 2.99792458 \times 10^8$ (m/s). Light is an electromagnetic wave, and the permittivity of free space (measured in F/m) and the permeability of free space (measured in H/m) determine the speed of light as the maximum propagation speed of an electromagnetic wave.

The dielectric permittivity can be expressed in terms of the speed of light and magnetic permeability as $\epsilon_0 = (4\pi \times 10^{-7} c^2)^{-1} = 1/\mu_0 c^2$ so $\mu_0 = 1/\epsilon_0 c^2$. Since potential permeability is the inverse of dielectric permittivity $\epsilon_g = 1/\epsilon_0$, it follows that $\mu_0 = \epsilon_g/c^2$ and $c^2 = \epsilon_g/\mu_0 = \epsilon_g\mu_g$. Therefore, we define the kinetic permeability of gravity as the inverse of magnetic permeability: $\mu_g = 1/\mu_0 = 1/1.25663706 \times 10^{-6} = 7.958 \times 10^5$. Since $\epsilon_g = 1/\epsilon_0$, the speed of the body with mass will be equal to $v_g = 1/\sqrt{\epsilon_g\mu_g} = 1/c = \sqrt{\epsilon_0\mu_0} = 3.336 \times 10^{-9}$ m/s. The speed of a body with mass is inversely related to the speed of light. The resulting speed will be the minimum possible speed of the mass's movement, or the minimum rate of motion. Gravitational velocity, like the speed of light, has a constant value. It should be recalled that the velocities are determined using permeability values at a distance of 1 m.

Thus, an inversion of the medium's magnetic permeability occurs in electrodynamics, and of kinetic permeability in gravitation. The potential and kinetic permeabilities of free space determine the minimum speed of bodies with mass. The speed of a body with mass is inversely proportional to the speed of light and is also constant.

4. Inversion of Electric and Potential Field Strengths

The electric field strength produced by a charged body is a vector quantity representing the force exerted by the electric field on a unit positive test charge placed at that point. From Coulomb's law (1), the electrical field strength in a given direction $\mathbf{a}_r$ is calculated as

$$\mathbf{E} = \frac{F_k}{q_t} = k \frac{q}{r^2} \mathbf{a}_r \text{ N/C}, \quad (8)$$

where q_t is a test charge of small magnitude.

Electric induction $\mathbf{D} = \epsilon_0 \mathbf{E}$. Electric field strength decreases as the square of the distance due to power dissipation. Opposite charges move toward each other (attract) due to the law of conservation of energy and charge induction [7]. When the magnitude of a charge on a body or its spatial location changes, processes instantly arise in another body due to induction; in accordance with the law of conservation of energy, these processes first establish the upper limit (threshold) to which the body's charge must change. Then, due to inherent inertia, this charge level gradually stabilizes within the body. The bodies begin to move toward each other until they make contact and their charges are neutralized.

The potential field strength generated by a body with mass is a vector quantity indicating the force with which the field of the massive body acts on a body with negative test mass placed at that point. It was believed that mass is always positive. However, it has been shown that when mass is represented as a complex number—that is, taking into account potential and kinetic intensities—and complex and hypercomplex numbers are conformally mapped onto the space of rotations, mass rotating around the coordinate system's origin can assume both positive and negative values [1]. As a body with mass is moved away from the zero point of equilibrium rotation, the potential tension binding these bodies decreases. To restore equilibrium, a kinetic stress term with the opposite sign is added, analogous to the magnetic component in the Lorentz force formula. This force pulls a body of a certain mass into an orbit of rotation. Thus, we obtain the infinite rotation of bodies and, consequently, harmonic oscillations of potential and kinetic energy. The physics of this phenomenon is also explained by self-induction. In the complex plane, these oscillations are shifted by $\pi/4$.

Let us define the potential intensity using Newton's law (2) as

$$\mathbf{P} = \frac{F_g}{m_t} = G \frac{m}{r^2} \mathbf{a}_r \text{ N/kg}, \quad (9)$$

where mt is a small test mass.

As can be seen from (9), the potential intensity of the mass also decreases with the square of the distance. Consequently, the force of interaction between the two masses decreases. Using expressions (5) and (6), let us express the electric field strength in terms of equivalent masses:

$$\mathbf{E}_{k,m} = \frac{F_{k,m}}{m_{t,m}} = G \frac{m_e}{r^2} \mathbf{a}_r \text{ N/kg.} \quad (10)$$

The potential due to equivalent charges will take the form:

$$\mathbf{P}_{g,q} = \frac{F_{g,q}}{q_{t,e}} = k \frac{q_e}{r^2} \mathbf{a}_r \text{ N/C.} \quad (11)$$

As can be seen from formulas (8), (10) and (9), (11), they employ inverse Coulomb constants and gravitational constants. Thus, electric and potential field strengths can be expressed in terms of both charges and masses, using equivalent masses and charges. In this context, the formulas employ inverse gravitational constants and Coulomb constants.

5. Inversion of the Capacitance of a Charged Body and the Capacitance of a body with Mass

The capacitance of a charged body is defined by the ratio of the body's charge to the electric field strength E produced by the charge at a point at a given distance equal to the magnitude of the vector $\mathbf{a}_r$ [1]:

$$C = \frac{q}{|\mathbf{E}| \mathbf{a}_r} \text{ F.} \quad (12)$$

In Coulomb's law (1), the Coulomb constant is equal to $k = 1/4\pi\epsilon_0$, where k also determines the capacitance density of the charged sphere: $C_q = 4\pi\epsilon_0 = 1/k$.

The complex impedance of a capacitor is given by: $Z_C = -jX_C = -j/\omega C$. As can be seen, the impedance is purely imaginary; the factor j indicates that the alternating current leads the voltage in phase by $\pi/2$. The capacitance, taking into account the expression for electric field strength (8), is equal to

$$C_q = \frac{q}{\mathbf{E}} = \frac{q}{\frac{q}{4\pi r^2 \epsilon_0} \mathbf{a}_r} = 4\pi r^2 \epsilon_0. \quad (13)$$

As can be seen from (13), the charge is absent from the definition of capacitance. In that case, capacitance is defined not as the ability to store charge, but as the ability of a charged body to generate an electric field intensity. According to Gauss's law, the charge of a body is calculated as the integral of the electric field intensity over a surface surrounding the body. At a distance equal to the length r of the vector $\mathbf{a}_r$ the capacitance density at the vector's endpoint will be equal to

$$C_q(r) = 4\pi\epsilon_0 r = \frac{r}{k} = rG \text{ F.} \quad (14)$$

It is known that the capacitance of a capacitor decreases as the plates are moved apart, in proportion to the distance between them. In our case, the capacitance (14) increases in proportion to the distance. This is due to the fact that the capacitor is considered in a one-dimensional space, whereas we are considering the system in a hypercomplex space. For a quaternion, this is a 4D space with three imaginary axes and one scalar axis. As the dimensionality of the space increases, its capacity grows, since its surface area and volume increase.

Thus, electrical capacitance is determined by the permittivity of free space ϵ_0 , the constant 4π , and the radius r of the charged body. As shown by (14), capacitance increases with distance, inversely proportional to the Coulomb constant and proportional to the gravitational constant. The larger r is, the greater the capacitance and the lower the resistance. The resulting expression coincides with the known expression for the capacitance of a conducting sphere, where capacitance increases as the radius of the sphere increases. The unit of

measurement for permittivity is F/m. When multiplied by meters, the result is a capacitance value in Farads.

We define the capacitance of bodies with mass in terms of the body mass and the potential intensity $\mathbf{P}$ in the direction of the vector $\mathbf{a}_r$, using a formula analogous to (12) [1]:

$$C_m = \frac{m}{|\mathbf{P}| \mathbf{a}_r} \text{ F.} \quad (15)$$

Substituting the expression for the potential intensity (9) into (15), we obtain the expression for the capacitance of a spherical body:

$$C_m = \frac{m}{G \frac{m}{r^2} \mathbf{a}_r} = \frac{r^2}{G \mathbf{a}_r} = k \frac{r^2}{\mathbf{a}_r} \text{ F.} \quad (16)$$

In the determination of the capacitance of a body of mass (16), the masses cancel out. The capacitance at a distance r from the origin at the tip of the vector takes the form:

$$C_m(r) = \frac{r}{4\pi\epsilon_0} = \frac{r\epsilon_g}{4\pi} = kr = \frac{r}{G} \text{ F.} \quad (17)$$

It is evident from (17) that the potential intensity decreases, while the capacitance increases in proportion to the distance. This phenomenon is also explained by the fact that the dimensionality of the hypercomplex space increases at a greater rate than the Coulomb constant decreases with distance. The electric capacitance density in (14) is the inverse of the mass capacitance density in (17). Thus, electrical capacitance does not depend on the charge but is determined by the permittivity, the radius of the charged body, and the distance between the charged bodies. Mass capacity does not depend on mass itself but is determined by potential permeability, the radius of the massive body, and the distance between the massive bodies. The greater the distance, the greater the capacity. The capacitance density of charged bodies is the inverse of the capacitance density of bodies with mass, since the capacitance of a body with mass increases in proportion to the Coulomb constant and is inversely proportional to the gravitational constant, whereas electrical capacitance behaves in the opposite manner.

6. Inversion of Electrical Inductance and Kinetic Inductance

Electrical inductance represents a form of momentum (kinetic or rotational energy) and serves as a measure of the ability of conductors to store a magnetic field, as well as the kinetic energy stored within that magnetic field. It is known that the electron possesses a magnetic moment and spin. The impedance of an inductor is complex and purely imaginary: $Z_L = jX_L = j\omega L$.

Inductance L is defined as the proportionality factor between the electric current I flowing in a closed loop and the total magnetic flux Φ generated by this current through the surface bounded by that loop:

$$L = \Phi / I. \text{ H.} \quad (18)$$

Magnetic flux Φ is a scalar physical quantity indicating how many magnetic flux lines pass through a given area S . Magnetic induction $\mathbf{B}$ is a vector physical quantity indicating the force with which the field acts on charged particles and bodies moving in any direction. Inductance (18) represents the ability of a charged body to generate circular currents and, consequently, magnetic field strength upon rotation. A circulating current can also be generated in the conductor of the coil. Rotation occurs in Rutherford's planetary model of the atom, which features a positively charged nucleus at its center, around which electrons orbit like planets around the Sun. Classical physics predicted that an accelerating electron should continuously radiate energy and rapidly spiral into the nucleus. However, as is well known, this does not happen. As a result, it was concluded that the Rutherford model is incorrect. Niels Bohr proposed the theory of stationary orbits, in which an electron revolves around the nucleus only in specific circular orbits and does not emit energy while doing so. The model proved inadequate for multi-electron atoms. Modern theory takes into account the wave properties of the electron—rejecting the notion that it follows a definite trajectory—and describes the atom using a quantum model in which a massive nucleus is surrounded by an electron "cloud," where the electron's position is defined by probability.

However, if electrons do not fall into the nucleus, then Rutherford's planetary model simply incorrectly describes the mechanism of

electron rotation in terms of energy loss due to acceleration. In reality, such a mechanism exists, and it is called self-induction. In self-induction, a change in the magnetic flux Φ around a conductor generates an electric current opposing the current in the conductor. The electromotive force (EMF) of self-induction in a coil with constant inductance L is expressed in terms of the inductance:

$$U = -\frac{d\Phi}{dt} = -L \frac{dI}{dt} \text{ V.} \quad (19)$$

As follows from formula (19), the inductance is numerically equal to the electromotive force of self-induction arising in the circuit when the current changes by 1 A in 1 s. Self-induction has a negative sign and compensates for the change in magnetic flux in accordance with the law of conservation of energy. Accordingly, changes in current are compensated for. Magnetic induction $\mathbf{B}$, like electric induction $\mathbf{D}$, does not depend on the permeability of the medium and, consequently, is not subject to limitations on the speed of propagation of the influence. Therefore, the change in charge values occurs instantaneously, and the subsequent compensation for this change takes place with an inertia determined by the magnetic permeability of free space, $\mu_0 = 4\pi \times 10^{-7} = 1.25663706 \times 10^{-6} \text{ H/m}$.

The circulation of the magnetic field intensity vector $\mathbf{H}$ along any closed loop is equal to the total net current. Magnetic induction is given by $\mathbf{B} = \mu_0 \mathbf{H}$, while the magnetic field strength produced by a differential element of the wire is calculated using the Biot-Savart-Laplace law. The Biot-Savart law resembles Coulomb's law for a differential charge: $dE = k \frac{dQ \mathbf{a}_r}{r^2}$. Both laws exhibit an inverse-square dependence on distance and a linear relationship between the source and the field. The main difference lies in the direction of the field. The electric field intensity between charges is directed from one charge to the other, whereas the field intensity produced by a rotating charge is directed perpendicular to the plane of rotation. We express the electric inductance density as $L_q = 4\pi\mu_0 \text{ H/m}$.

Thus, the mechanism that keeps the electron in orbit in Rutherford's planetary model of the atom is electrical self-induction, which operates in accordance with the law of conservation of energy. Due to self-induction within the atomic nucleus and the electron itself, the process of the electron orbiting the nucleus can continue indefinitely without energy loss, involving a constant exchange between electric field energy and magnetic field energy.

The planetary model of the atom is consistent with the inverse relationship between electrodynamics and gravitation. Bodies with mass also orbit stars. It has been shown above that, due to the inverse relationship, the scales of planetary rotations and masses are significantly larger than the scales of atoms. However, the physical principles and laws remain unchanged.

The complex impedance of an inductor is also expressed as a complex number: $Z_L = jX_L = j\omega L$. In this case, the voltage across the inductance leads the current in phase by $\pi/2$. Phase shifts between dual quantities imply the formation of circulation in a plane, and in space the helical motion of waves and bodies. Under a conformal mapping of a hypercomplex space, we define the kinetic inductance L_m associated with the rotation of bodies with mass as the proportionality coefficient between the kinetic mass current I_m representing the orbital rotation of the mass and the total kinetic mass flux Φ_m generated by this current through a surface S bounded by the orbit in the direction of the vector $\mathbf{a}_r$:

$$L_m = \frac{|\Phi_m|}{I_m} \mathbf{a}_r,$$

where the vector $\mathbf{a}_r$ passes through the surface S .

Since the magnetic permeability of free space for gravity is the inverse of the magnetic permeability of free space for electrodynamics i.e. $\mu_g = 1/\mu_0 = 1/4\pi \cdot 10^{-7}$, the density of the kinetic inductance of space will be equal to

$$L_m = 4\pi\mu_g = 4\pi/\mu_0 = \frac{4\pi}{4\pi \times 10^{-7}} = 10^7 \text{ H/m}.$$

The speed of mass movement is the inverse of the speed of light and is constant.

$$v_g = 1/\sqrt{\varepsilon_g \mu_g} = 1/c = \sqrt{\varepsilon_0 \mu_0} = \frac{1}{\sqrt{C_m L_m}} = 3.336 \cdot 10^{-9} \text{ m/s}.$$

Thus, the free space containing bodies can be described in terms of the capacitance and inductance of the moving and rotating bodies. Capacitance and inductance are measures of inertia. Bodies positioned opposite each other serve as the capacity for the bodies. Under

gravity, according to Newton's law, bodies with mass attract each other. The Earth and the Sun possess mass and, consequently, attract each other. However, Earth, like other planets, does not fall into the Sun but orbits it. Similarly, in the microworld of atoms, negatively charged electrons do not fall into the positively charged atomic nucleus but orbit it endlessly without losing energy. The energy-loss-free rotation mechanism is explained by the presence of an oscillatory circuit comprising capacitance and inductance. In the context of gravity under conformal mapping, the rotation of bodies occurs within a spatial coordinate system centered on the Sun, consequently, a mass increment involving both positive and negative values takes place. In accordance with the hypercomplex representation of space, mass increments vary according to harmonic laws.

Capacitance and inductance are formed between the planets and the Sun. Capacity is characterized by potential intensity that is, the interaction of masses in the form of attraction. Inductance is characterized by kinetic intensity in the form of the rotation of masses. As is well known, planets revolve around the Sun and rotate on their axes, thereby generating kinetic tension. Moreover, planets typically have a core of plasma formed due to high pressure. Consequently, the plasma can change its rotation speed and, accordingly, alter the kinetic intensity.

Hundreds of dark spots are observed on the Sun; these are regions where strong magnetic fields emerge. This effect indicates the presence of inductances that interact with the planets, adjusting their orbits. Since there are eight planets, each with a different rotational speed, axial tilt, and mass, there must be a greater number of regulating inductances in the form of dark spots to form a MIMO system. Unfortunately, there are currently no statistics regarding the link between the presence and location of dark spots and the positions of the planets.

The Sun is located at the center of the planetary rotation coordinate system. Under the conformal mapping of a hypercomplex space, the coordinate axes of the space are imaginary, that is, spectra are mapped onto them. One half of the spectrum on the positive axes is associated with the scalar part, that is, with a particular observed planet. The other half forms a mirror image of the planet's motion trajectory on the negative axes. The other half forms a mirror image of the planet's trajectory on the negative imaginary axes. This effect is known from the analysis of the Fourier transform. Typically, in a complex analysis, the mirror-image component is not used; instead, the positive part of the coordinate system is isolated from the spectrum and treated as the real component.

However, these parts are closely interconnected by induction. Moreover, a change in one part of the mirror-image spectra is instantly transmitted to the other part and is independent of the propagation medium. Since the mirror component of the spectrum has the opposite direction of rotation, it acts as self-induction and regulates changes occurring in the real component—that is, in the planet's trajectory. As is well known, the spectrum amplitude decreases with increasing frequency; therefore, position adjustment is primarily carried out at low frequencies, while the less significant components are subsequently refined through inertia.

7. Calculation of Earth's Orbital Speed

Let us compare the measured data with the values calculated using the given formulas, taking Earth as an example.

The speed of light is calculated as $c = 1/\sqrt{\mu_0 \epsilon_0} = 2.99792458 \cdot 10^8$ m/s. The rate of transfer of potential and kinetic energy between bodies with mass is limited by a speed inversely related to the speed of light $v_{c_min} = 1/\sqrt{\epsilon_m \mu_m} = 1/c = \sqrt{\epsilon_0 \mu_0} = 3.336 \cdot 10^{-9}$. In this case, the values of ϵ_0 and μ_0 correspond to a distance of 1 m. Since the velocities are constant, an increase in dielectric permittivity or potential permeability with increasing distance must be accompanied by a decrease in magnetic permeability and kinetic permeability, such that their product remains constant. Accordingly, the product of capacitance and inductance must also be independent of distance, and consequently, in accordance with the formula $T = 2\pi\sqrt{CL}$, the orbital period of the planets must not change with distance.

The measured orbital period of the Earth around the Sun is $T_{m_eth} = 3.156 \times 10^7$ s. As is well known, the Earth revolves around the Sun and simultaneously moves along with the Sun. Maxwell's equations for a quaternion show that the Earth moves along a helical trajectory [1]. When observed from Earth while moving in tandem with the Sun, it will recede from or approach Earth, causing its orbit to appear elliptical. The projection of a helix onto a plane perpendicular to the direction of motion is a circle. Therefore, let us consider the minimum distance to the Sun (perihelion) as the radius of Earth's orbit, assuming it to be circular.

We will consider the minimum orbital radius $R_{c_eth} = 1.471 \times 10^{11}$ m to be the calculated radius of the circle. As is known, the measured speed of the Earth's motion along its elliptical orbit is $V_{m_eth} = 2.978 \times 10^4$ m/s. Consequently, during the period of Earth's revolution around the Sun, T_{m_eth} , the Earth will travel a certain distance along its elliptical orbit $L_{m_eth} = V_{m_eth} T_{m_eth} = 9.398 \cdot 10^{11}$ m. As can be seen, L_{c_eth} is slightly smaller than L_{m_eth} , since the radius of the circular orbit is smaller than the average radius of the elliptical orbit.

The wavelength at the minimum movement speed v_{c_min} over the duration of one revolution T_{m_eth} will be $\lambda_{c_min} = v_{c_min} T_{m_eth} = 0.105$ m. Recall that such a small distance corresponds to capacitance and inductance per meter. The circumference is an integer multiple of the

wavelength, therefore, the radius of the circle is $R_{c_min} = \lambda_{c_min} / 2\pi$.

The calculated circumference of Earth's orbit exceeds the wavelength by a factor of $L_{c_eth} / \lambda_{c_min} = 0.928 \times 10^{12}$. Consequently, the Earth's orbital speed at a radius of R_{c_eth} will be $V_{c_eth} = 2.929 \times 10^4$ m/s. In other words, when rotating at the minimum speed calculated for the capacitance and inductance at a distance of 1 m, the Earth completes one revolution corresponding to $\lambda_{c_min} = 0.105$ m. At a distance equal to the orbital radius R_{c_eth} , the velocity becomes $V_{c_eth} = 2.929 \times 10^4$ m/s. As can be seen, the calculated circular orbital velocity V_{c_eth} differs only slightly from the measured elliptical orbital velocity V_{m_eth} .

Let us calculate the Earth's period of rotation using capacitance and inductance according to the formula $T_{c_eth} = 2\pi \sqrt{C_m L_m}$. At the minimum mass velocity of $v_{c_min} = 1 / \sqrt{\epsilon_m \mu_m} = 3.336 \cdot 10^{-9}$ m/s, the wavelength is $\lambda_{c_min} = 0.105$ m; consequently, the radius of the circle is $r = \lambda_{c_min} / 2\pi = 0.017$ m. Accordingly, the capacitance at distance r is $C_m = r \cdot k = 1.502 \times 10^8$ F. The inductance at distance r is $L_m = r \cdot 4\pi / \mu_0 = r \cdot 10^7 = 1.671 \times 10^5$ H. Hence, the rotation period is $T_{c_eth} = 3.148 \times 10^7$ s. If we take the distance r outside the root sign, we get $T_{c_eth} = \lambda_{c_min} v_{c_min} = L_{c_eth} V_{c_eth} = 3.148 \times 10^7$. The result obtained for the circular orbit differs slightly from the value measured for the elliptical orbit, $T_{m_eth} = 3.156 \times 10^7$ s.

Thus, the planet's speed of motion and its orbital period can be calculated using a minimum mass velocity equal to the reciprocal of the speed of light, with the circumference also being minimal and determined by the wavelength. Since the planet's speed and consequently the circumference of its orbit, increases in proportion to the radius, the orbital period remains unchanged.

8. Conclusion

A connection has been established between electrodynamics and gravity as an inversion of the fundamental parameters of free space. This shows that the microworld operates according to the same laws as the macroworld. All elements of the micro- and macro-worlds are interconnected within a MIMO-like system, which contributes to an increase in the system's energy. Changes in any elements of the systems are instantly transmitted to other elements via induction, in accordance with the law of conservation of energy. Subsequently, changes occur in the elements over a period of time determined by inertia.

Since the conformal mapping of a hypercomplex space onto the space of rotations takes place, the rotation of planets occurs around a center in the form of a star, for example, the Sun. There are approximately 200 sextillion stars in the universe, that is, a number followed by 23 zeros. Each star with its planets forms its own system of rotations and its own coordinate system within hypercomplex space. Consequently, outer space or the universe is not limited to three dimensions but possesses a very high dimensionality, mathematically described by hypercomplex numbers. Three-dimensionality is local and is described by a quaternion in the form of three imaginary coordinate axes and one scalar axis. Since the dimension of hypercomplex numbers increases through doubling, an octonion with seven imaginary coordinates and one scalar coordinate is obtained from four quaternions, and so on. However, the local three-dimensionality of space is preserved, and we observe it at any point in space.

Imaginary spatial coordinates have the dimension of frequency; that is, they represent rotations with frequencies that increase as one move away from the center. In this case, the rotations are mirror-symmetric for the positive and negative axes. Spatial coordinates represent mirror-image frequency spectra corresponding to induction. Induction with the opposite sign is used to correct planetary orbits, as it creates a mirror image determined by the law of conservation of energy. It is evident that induction acts instantaneously, since the primary spectrum and the mirror spectrum are closely linked. It is hypothesized that sunspots are inductances formed by plasma.

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