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On the Nature of Inertia and Newton's Laws

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Abstract

This work continues the author's research into the applicability of the concept of a compressible oscillating ether to the description of the nature of various physical laws and equations. The laws of classical Newtonian mechanics, which for over three hundred years were considered axioms based solely on the generalization of experimental data, are examined. A formula for the force acting on material bodies moving in the ether is derived from the ether equations. Based on this formula, it is proven that inertial forces (Newton's first law), including centrifugal force, are real forces of ether resistance to a change in a body's state of rest or its state of uniform and rectilinear motion. It is also demonstrated that the law of motion of bodies (Newton's second law) is also a consequence of the formula for the force acting on material bodies moving in the ether.

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Introduction

The year 2027 marks 340 years since Isaac Newton published in his book Mathematical Principles of Natural Philosophy the law of universal gravitation and the three most important laws of classical mechanics, which allow us to write the equations of motion for any mechanical system if the forces acting on its constituent bodies are known [1]. In Newton's presentation of mechanics, which is still widely used today, these laws are axioms based on a generalization of experimental results. Newton's first law is known as the law of inertia and is formulated as follows. There are reference systems, called inertial, relative to which material points, when no forces act on them (or when mutually balanced forces act on them), are in a state of rest or uniform rectilinear motion. Newton himself formulated the first law of mechanics differently. "Everybody continues in its state of rest or uniform motion in a straight line, unless and until it is forced by external forces to change this state." The concept of an inertial frame of reference is absent from Newton's work; instead, Newton speaks of absolute space and absolute time. From a modern perspective, this formulation of Newton's law is considered unsatisfactory, as modern physics rejects the existence of an absolute, motionless frame of reference, that is, absolute space and absolute time.

It is also believed that the term "body" should be replaced by the term "material point," since a finite body can also undergo rotational motion in the absence of external forces. Thus, modern classical mechanics postulates the existence of non-inertial frames of reference that accelerate relative to inertial frames. The simplest non-inertial reference frames are those moving with acceleration in a straight line and rotating frames. More complex systems are combinations of the two. It is also believed that Newton's second law of motion is formulated only for inertial frames. To ensure that the equation of motion of a particle in a non-inertial frame of reference matches the equation of Newton's second law, in addition to the "ordinary" forces acting in inertial systems, inertial forces are introduced, the most well-known and important of which is centrifugal force.

Inertial forces are often accompanied by additional definitions, such as fictitious or apparent forces. The question of whether inertial forces are real forces remains unresolved in modern science. For example, Academician A. Yu. Ishlinskii believed that inertial forces introduced in non-inertial systems are fictitious forces, i.e., non-existent [2]. However, another prominent mechanic, Academician L. I. Sedov, believed that inertial forces are real forces [3]. Newton himself believed that inertial forces are the forces of resistance of the ether to the accelerated motion of material bodies relative to absolute space. Newton considered these forces to be proportional only to mass and independent of the speed, shape, and cross-sectional area of the body, and the density of the medium itself, and he called the existence of such forces an "innate property of matter." Newton also considered the forces of gravitational "attraction" to be proportional to the masses of the interacting bodies, but by the word "attraction" he understood "the tendency of bodies to approach each other, whether this tendency arises from the action of the bodies themselves, or is caused by the ether, or in general by any medium, material or immaterial.

That is, Newton himself did not consider the law of universal gravitation to be the law of attraction of bodies, as the modern formulation of the law states. He also didn't believe that gravitational interaction propagates between bodies instantaneously in empty space, and instead believed that the cause of gravitational interaction was the ether. "The ether, which permeates all bodies and is contained in them...," Newton wrote. But Newton didn't know what ether was or how it affected bodies, since no mechanical properties of the hypothetical ether could explain the natural phenomena, he observed. Thus, Newton abandoned the explanation of the ether's nature, considering it a subtle, all-pervading, and possibly immaterial medium that is not only external to the moving body but also resides within the body itself and, in all likelihood, somehow interacts with the ether outside the body. "Perhaps, then, all things are derived from ether," Newton wrote regarding the nature of gravity.

According to the author, the ambiguity in the interpretation of inertial forces in modern science arose solely due to the unjustified exclusion of the ether from all modern theoretical physical constructs, replacing it with the meaningless concept of a matter-free physical vacuum. The purpose of this article is to demonstrate that recognition of the existence of an etheric medium unambiguously leads to recognition of the reality of inertial forces in their original Newtonian interpretation, denoting the counterforces of Newton's third law. That is, the forces of ether's resistance to forces attempting to change a body's state of rest or its uniform and rectilinear motion. The reality of inertial forces in the Newtonian interpretation was also recognized by the eminent French mathematician A. Poincaré, as follows from his statement: ‘It is not matter but the ether that possesses inertia; it alone resists motion” [4]. Recognition of the reality of inertial forces means recognition of the reality of the ether. In addition, the work will prove that not only Newton's first law (the law of inertia), but also Newton's second law (the law of motion), Newton's third law (the law of equality of action and reaction) and the law of universal gravitation are not axioms, but a direct consequence of the existence of a real etheric medium described by the theory of compressible oscillating ether.

Structure And Properties of Compressible Oscillating Ether

The theory of the ether as a compressible oscillating medium is developed in the author's works [5-8]. Like any continuous medium, the ether must have a "density" $\rho\ (t,\ \mathbf{r})$. However, being immaterial, the "density" and "mass" of the ether do not necessarily have the dimensions of the density and mass of matter. Moreover, the vectors $\mathbf{r}(t)$ and $\mathbf{u}\ (t,\ \mathbf{r})\ =\ d\mathbf{r}(t)/\ dt$ do not necessarily represent the trajectory and velocity of points in the ether, since the existence of ether flows contradicts common sense and everyday empirical observations. The most reasonable and consistent with common sense is Lorentz's concept of a stationary ether, since in this case, Newton's absolute space and absolute time can be associated with the ether. However, Lorentz's ether is in no way connected to matter and does not generate matter, and therefore the existence of free movement of any material bodies through dense ether appears at the very least mysterious. This contradiction is resolved by the assumption that the ether, being globally immobile, allows waves of any complexity to propagate through it via rapid oscillatory movements of its elements and small perturbations of its density. Therefore, the equations of the ether must describe, at each moment t, the changes in the coordinate $\mathbf{r}(t)$ and the propagation velocity $\mathbf{u}(t,\mathbf{r})$ of its local perturbations, including perturbations of its density $\rho(t,\mathbf{r})$. It is obvious that such a system of equations must have at least two equations, one of which must be the well-known equation of continuity of a continuous medium, and the other must be the equation of motion of the medium, which in the theory of compressible oscillating ether is the constancy of the flux density of ether perturbations $\rho(t,\mathbf{r})\mathbf{u}(t,\mathbf{r})$that is

$$\frac{\partial\rho}{\partial t}+\nabla\cdot(\rho\mathbf{u})\ =\ 0,\qquad \frac{d\rho\mathbf{u}}{dt}\ =\ \frac{\partial\rho\mathbf{u}}{\partial t}+(\mathbf{u}\cdot\nabla)(\rho\mathbf{u})\ =\ 0. \qquad (1)$$

Material bodies, in this case, are specific local perturbations of the ether's density, and their motion is the displacement of complex wave packets of local perturbations in a globally stationary oscillating ether, as occurs, for example, with the propagation of waves on the surface of water. Ethereal space itself, as our everyday experience and common sense suggest, is a three-dimensional Euclidean space. Indirect confirmation of this is provided by Coulomb's laws and the laws of universal gravitation, which have squared distances between charges (bodies) in their denominators, a characteristic exclusively of the third-dimensionality of space.

If we assume that the density of the ether has a dimension, then the form of this dimension must be $[\rho] = cm^{-3/2}\cdot g^{1/2}\cdot s.$ Only in this case, the dimensions of all physical quantities found from the formulas of the theory of ether coincide with their dimensions in the natural system of units of the CGS [5,6]. There can be no other dimension. It is important that the product of the charge and the density of the ether have the dimension of mass, that is, $[q\rho] = g$. A different matter if we assume that the ether is immaterial and its density has no dimension (dimensionless). In such a system, the dimension of the ether coincides with the dimension of volume, and the dimensions of all basic physical quantities are expressed through integer powers of the dimensions of length (cm) and time (s). This means that in the CS (cm, s) system there is only absolute Newtonian three-dimensional Euclidean space filled with bound oscillating elements of the ether (called newtoniums, as proposed by D.I. Mendeleev[9], and absolute time, while all other physical quantities are their derivatives, the dimensions of which are expressed as integer powers of the dimensions of space and time. Moreover, the gravitational constant is dimensionless, and the dimensions of mass and charge coincide, which emphasizes their common origin from the ether [5,6]. The author supports the adoption of precisely this system of units of physical quantities CS (cm, s).

Derivation Of the Equation for the Ether Resistance Force

Let's derive an equation for the force exerted by the ether on a charge moving through the ether with velocity u. To do this, we introduce the etheric definitions of the magnetic field induction vector **B** and the electric field strength vector **E**:

$$\mathbf{B}\ =\ c\nabla\ \times\ (\rho\mathbf{u}),\qquad \mathbf{E}\ =\ (\mathbf{u}\cdot\nabla)(\rho\mathbf{u}), \qquad (2)$$

where c is the speed of light (the speed of sound in the ether), and ∇ is the differential operator nabla. Then, applying the divergence operator ∇· to expressions (2), we immediately obtain the last two equations from Maxwell's system of equations.

$$\nabla \cdot \mathbf{B} = 0, \quad \nabla \cdot \mathbf{E} = 4\pi\sigma, \tag{3}$$

where the charge distribution density σ, determined by the perturbations of the ether density, has the form

$$4\pi\sigma = \nabla \cdot (|\mathbf{u}|\nabla(\rho|\mathbf{u}|)) - \nabla \cdot (\mathbf{u} \times (\nabla \times (\rho\mathbf{u}))). \tag{4}$$

We apply the rotor operator $c\nabla\times$ to the second equation of the ether equations system (1). We immediately obtain the first equation from the Maxwell's equations system:

$$\nabla \times \mathbf{E} = -\frac{1}{c}\frac{\partial \mathbf{B}}{\partial t}, \tag{5}$$

which is a generalization of Faraday's law of induction. The most difficult part is deriving the second equation from Maxwell's equations, which contains the current density j. A detailed derivation of this equation is given by the author in the book [6]. Applying the operator **(u·∇)** to the second equation from system (1) and using vector analysis formulas, we find that

$$\frac{\partial \mathbf{E}}{\partial t} - \nabla \times \left(\frac{|\mathbf{u}|^2}{c}\mathbf{B}\right) + 4\pi\mathbf{j} = 0, \tag{6}$$

where

$$4\pi\mathbf{j} = (((\mathbf{u}\cdot\nabla)(\rho\mathbf{u}))\cdot\nabla)\mathbf{u} + \mathbf{u}(\nabla\cdot((\mathbf{u}\cdot\nabla)(\rho\mathbf{u}))) - ((\mathbf{u}\cdot\nabla)(\rho\mathbf{u}))(\nabla\cdot\mathbf{u}) - \nabla\times(\mathbf{u}\times(\nabla(\mathbf{u}\cdot(\rho\mathbf{u}))$$
$$- ((\rho\mathbf{u})\cdot\nabla)\mathbf{u} - (\rho\mathbf{u})\times(\nabla\times\mathbf{u}))) + \nabla\times(\mathbf{u}(\mathbf{u}\cdot(\nabla\times(\rho\mathbf{u})))) - (((\nabla\cdot\mathbf{u})\mathbf{u} - (\mathbf{u}\cdot\nabla)\mathbf{u})\cdot\nabla)(\rho\mathbf{u})$$

In the case $|u| \approx c$ where equation (6) transforms into the last fourth equation of the Maxwell system of equations, and the linearized system obtained in this way transforms into the classical linear system of Maxwell equations. Maxwell's equations were formulated solely on the basis of a generalization of the empirical laws of electrical and magnetic phenomena. As noted in the textbook on theoretical physics: "Maxwell's equations do not follow from any more general theoretical principles, but are a generalized record of experimentally observed facts [10]." In works, the author proved that this is not the case and that Maxwell's equations are a consequence of the system of ether equations (1). The solution to Maxwell's system of equations is a classical transverse electromagnetic wave, while the solution to the ether equations (1) is a longitudinal-transverse screw wave (photon). When transitioning from the ether equations to Maxwell's equations, the longitudinal component of the wave is lost as a result of differentiation [5,6]. Furthermore, the ether equations also have solutions in the form of exclusively longitudinal waves, which are not solutions of Maxwell's equations. Thus, Maxwell's equations do not fully describe the essence of electromagnetic processes occurring in nature. They a priori lack a mechanism for transmitting interactions in space. The absolutization of Maxwell's equations and the speed of light was one of the main mistakes of physicists at the beginning of the 20th century. It is now clear that Maxwell's equations, like the Schrödinger equation, being linear equations, have a very limited range of solutions and cannot in any way claim the role assigned to them by modern science in the description of natural processes. Moreover, the transmission of interaction via short-range interaction obviously requires a medium (ether), and Michelson's experiments to detect ether wind yielded negative results. And here, the fundamental, erroneous, purely speculative conclusion was reached: that short-range interaction could occur without a medium to transmit it, in empty space. This led to the rejection of the ether as an entity unnecessary for these theoretical constructions and to the acceptance of many absurd theories that contradicted common sense. At the same time, the reasoned objections of many outstanding scientists of the old school of the early 20th century were ignored, such as Nobel laureates J. Stark, F. Lenard, J. Thomson, H. Lorentz, as well as N. Tesla, D. Mendeleev, V. Mitkevich, N. Zhukovsky, A. Timiryazev, and many others. It is now clear that the absence of an ether wind is not equivalent to the absence of the ether itself, since the movement of matter waves through a globally stationary oscillating ether should not be accompanied by an ether wind at the low speeds inherent in the movement of material objects. And uniform rectilinear motion occurs, as it will be demonstrated below, without any ether resistance.

In this work, however, we will be interested not so much in the derivation of the system of Maxwell's equations from the system of ether equations (1), but in the derivation of the equation for the force acting from the ether on a charge or mass moving in the ether with velocity u. From the second equation of the system of Maxwell's equations (2) and from equation (4) it follows that

$$\mathbf{E} = (\mathbf{u}\cdot\nabla)(\rho\mathbf{u}) = |\mathbf{u}|\nabla(\rho|\mathbf{u}|) - \mathbf{u}\times(\nabla\times(\rho\mathbf{u})) = |\mathbf{u}|\nabla(\rho|\mathbf{u}|) - \mathbf{u}\times\mathbf{B}/c. \quad (7)$$

Multiplying equation (7) by the charge q, we obtain the force acting from the ether on the charge

$$\mathbf{F} = q|\mathbf{u}|\nabla(\rho|\mathbf{u}|). \quad (8)$$

Clearly, force (8) is the Lorentz force $q(\mathbf{E}+\mathbf{u}\times\mathbf{B}/c)$, acting on a charge moving at velocity u in an electromagnetic field with vectors **E** and **B**. We will show that force (8) is not only the force of inertia, that is, the Newtonian force of resistance of the ether to the motion of material bodies, but also that the law of motion of Newtonian classical mechanics (Newton's second law) is also a consequence of formula (8) and is satisfied solely due to the existence of the etheric medium, just as the law of universal gravitation and Newton's third law on the equality of action and reaction forces during the interaction of two bodies. But, since all of Newton's laws are formulated in relation to the action of forces on the masses of bodies, and not on charges, it is necessary to establish a connection between the mass of a body, understood by Newton as the amount of substance, and the absolute value of the charges of elementary particles that make up this body, which will make it possible to interpret formula (8) as an expression for the force acting on a mass moving in the ether and at the same time to clarify the nature of Newton's law of universal gravitation.

Charges and Masses of Bodies. Newton's Law of Universal Gravitation

That gravity is somehow closely related to electric charges is indicated by one type of law of universal gravitation of two material bodies and Coulomb's law of interaction of two electric charges

$$\mathrm{F} = G\frac{m_1 m_2}{r^2}, \quad \mathrm{F} = \frac{q_1 q_2}{r^2}, \quad (9)$$

where the gravitational field strength created by mass *m is* $\boldsymbol{G} = Gm/r^2$ and has the dimension of acceleration in the CGS system $cm\cdot s^{-2}$, and the electrostatic field strength created by charge q is $E = q/r^2$ and has the dimension of $cm^{-1/2}\cdot g^{1/2}\cdot s^{-1}$in the CGS system. However, in the CS system, the dimensions of charge and mass coincide and are equal to $cm^3\cdot s^{-2}$. The dimensions of the gravitational and electrostatic field strengths also coincide, and the gravitational constant G is dimensionless. In the CGS system, the product of charge and the density of the ether has the dimension of mass $[q\rho] = g$. Along with the similarities, gravitational and electrostatic fields also have significant differences. Firstly, gravitational forces act between any bodies, and electric forces act only between charged ones. Secondly, gravitational forces are incomparably weaker than electrostatic forces and manifest themselves primarily in the presence of astronomical objects with enormous masses. Third, gravity is considered to contain only attractive forces, while electricity also contains repulsive forces. Fourth, the precision of experimental measurements of the gravitational constant G is several orders of magnitude lower than that of other physical quantities, and the precision ranges of different measurements do not overlap. This creates the persistent impression that the gravitational constant is not, in fact, a constant [11].

In the theory of compressible oscillating ether proposed by the author [5-6], the main structural elements of matter are the electron e and the proton p, which have charges equal in absolute value q, but opposite in sign. These particles, together with their antiparticles (positron and antiproton), are spherical wave solutions of the system of ether equations (1), generated by half-waves of curled photons of double period and having Compton radii $r_{e,p}$ such that the quantities $2\pi r_{e,p}$ are equivalent to the Compton wavelengths of the particles $2\pi\hbar/(m_{e,p}c)$, where $\hbar$ is Planck's constant, c is the speed of light. The particles themselves have constant angular velocities of propagation of azimuthal waves of compressions - expansions of the ether density $\omega_{e,p} = c/r_{e,p}$ inside their balls around their axes. Consequently, the radius of the proton sphere is approximately 1836 times smaller than the radius of the electron sphere, and the ether inside the proton is slightly compressed, and inside the electron is slightly rarefied compared to the unperturbed ether of constant density ρ_0.

The waves of perturbations of the ether density inside the proton and electron can interact in two different ways: having unidirectional or oppositely directed spins (the directions of the propagation axes of azimuthal waves of compressions - expansions of the ether density). In this case, the neutron is a superposition of the spheres of the electron and proton waves with a common center and with unidirectional spins, and the hydrogen atom is a superposition of the electron and proton waves with a common center, but with oppositely directed spins (see [5,6]). The charges that the electron and proton have are found by integrating the charge distribution density for the positive and negative half-waves of a curled photon of doubled period inside spheres of radii $r_{e'p}$ [5,6].

$$q_{\pm} = \pm \int_0^{\pi}\int_0^{2\pi}\int_0^{r_{e,p}} \frac{\rho_0\,\omega_{e,p}\,Z_{e,p}(\theta)}{8\pi r^2}\sin(\xi/2)\,r^2\sin\theta\,dr\,d\xi\,d\theta = \pm\frac{\rho_0 c V_q}{2\pi} = \pm\frac{\rho_0 V_0 c(4a+\pi)}{4\pi},$$

$$V_q = \int_0^{\pi} Z_{e,p}(\theta)\sin\theta\,d\theta,\quad Z_{e,p}(\theta) = V_0(a+\sin\theta+b_{e,p}\sin 2\theta + c_{e,p}\sin 3\theta),\quad V_0 \ll 1,\quad a = 1/7.$$

The magnitude of the particle's charge does not depend on its frequency and on the values of $b_{e,p}$ and $c_{e,p}$ in $Z(\theta)$, which are different for the electron and proton, from which it follows that the charges of the electron and proton differ only in sign, despite the enormous difference in size, frequency and energy. The electrostatic fields of the fundamental elementary particles (proton, electron) are found as solutions to the system of equations of the ether outside the particles, provided that the strength of the electrostatic field and small perturbations of the ether density outside the sphere of the elementary particle coincide at the boundary of the sphere with the electrostatic field and small perturbations of the ether density found inside the sphere

$$V = \frac{c r_{e,p}^2}{r^2},\quad \rho = \rho_0\left(1+\frac{Z_{e,p}(\theta)}{c r_{e,p}}\cos\left(\frac{\xi}{2}\right)\right),\quad \boldsymbol{E} \approx \pm\frac{c\rho_0}{2r^2}Z_{e,p}(\theta)\sin\left(\frac{\xi}{2}\right)\boldsymbol{i}_r,\quad \xi = \left(\omega t - \frac{r\varphi}{r_{e,p}}\right),$$

where V(r) is the radial stationary component of the velocity vector of propagation of electrostatic perturbations of the ether outside the sphere of the elementary particle. The proton's charge is positive, and its electrostatic field is directed toward the proton. The electron's charge is negative, and its electrostatic field is directed away from the electron. Averaging the obtained expressions for each $r > r_{e,p}$ over the surface of a sphere of radius r in space with coordinates (r,θ,ξ), we obtain that the electrostatic field strengths of elementary particles, depending only on the distances to the particle centers, have the form:

$$\mathbf{E}_{\pm} = \pm\frac{c\rho_0}{4\pi r^2}\int_0^{\pi}\int_0^{2\pi}\frac{Z_{e,p}(\theta)}{2r^2}\sin\left(\frac{\xi}{2}\right)r^2\sin\theta\,d\xi\,d\theta\,\boldsymbol{i}_r = \pm\frac{c\rho_0 V_q}{2\pi r^2}\boldsymbol{i}_r = \pm\frac{q}{r^3}\boldsymbol{r},$$

from which the validity of Coulomb's law follows for the forces of attraction (repulsion) acting between opposite (negative) charges. But the system of ether equations also has another solution, satisfying the condition of equality of small perturbations of the ether density and the radial propagation velocities of these perturbations at the boundary of the spheres of elementary particles. We will call this solution the gravitational field of the particle. It has the form

$$V = \frac{V_0 r_{e,p}}{r^2},\ \rho = \rho_0\left(1 + \frac{Z_{e,p}(\theta)}{c r_{e,p}}\cos\left(\frac{\xi}{2}\right)\right),\ \boldsymbol{G} = \pm\frac{\rho_0 V_0}{2r^2 r_{e,p}} Z_{e,p}(\theta)\sin\left(\frac{\xi}{2}\right)\boldsymbol{i}_r,\ \xi = \left(\omega t - \frac{r\varphi}{r_{e,p}}\right).$$

By averaging the obtained expressions for each $r > r_{e,p}$ over the surface of a sphere of radius r in space with coordinates (r,θ,ξ), we obtain that the intensities of the gravitational fields of elementary particles, depending only on the distances to the centers of the particles, have the form:

$$\boldsymbol{G}_{\pm} = \pm\frac{\rho_0 V_0}{4\pi r^2 r_{e,p}}\int_0^{\pi}\int_0^{2\pi}\frac{Z_{e,p}(\theta)}{2r^2}\sin\left(\frac{\xi}{2}\right) r^2 \sin\theta d\xi d\theta \boldsymbol{i}_r = \pm\frac{\rho_0 V_0 V_q}{2\pi r_{e,p} r^2}\boldsymbol{i}_r = \pm\frac{V_0}{c r_{e,p}}\frac{q}{r^3}\boldsymbol{r} = \pm s\frac{q}{r^3}\boldsymbol{r},$$

where $s_{e,p} = V_0/cr_{e,p}$ is a dimensionless coefficient. Consequently, the gravitational field of an elementary particle is directly proportional to the particle's charge, inversely proportional to the particle's radius, and inversely proportional to the square of the distance from the particle's center. In addition, the gravitational field of a proton is directed toward its center, while the gravitational field of an electron is directed away from its center. Thus, the gravitational field of an elementary particle is smaller than its electrostatic field by $cr_{e',p}/V_0$ times, and the gravitational field of an electron is smaller than the gravitational field of a proton by approximately 1836.15 times.

Let us express the mass of a proton through its charge, using the expression for the internal energy of a proton in the form $\hbar\omega_p = (\pi^2\rho^2_0 c V^2_0 d/4)\,\omega_p$, where d = 4.8385 is a dimensionless numerical coefficient, and $\hbar = \pi^2\rho^2_0 c V^2_0 d/4$ is Planck's constant [5,6]:

$$m_p = k s_p q \rho_0 = k\frac{V_0}{c r_p}\frac{\rho_0 V_0 c(4a+\pi)}{4\pi}\rho_0 = k\frac{\pi^2\rho_0^2 c V_0^2 d}{4 c r_p}\frac{(4a+\pi)}{\pi^3 d} = k\frac{\hbar\omega_p}{c^2}\frac{(4a+\pi)}{\pi^3 d} = \frac{\hbar\omega_p}{c^2},$$

where $k = \pi^3 d/(4a+\pi)$ is a dimensionless numerical coefficient. A similar result is valid for expressing the mass of an electron through the absolute value of its charge: $m_e = ks_e q\rho_0$. As a consequence, expressions were obtained for the relationship between the masses of elementary particles and their internal energies $E_{e,p} = \hbar\omega_{e,p} = m_{e,p}c^2$. Let us express the force of gravitational interaction $F_{pp}(r)$ of two protons through their masses

$$F_{pp}(r) = G_p(r)q = \frac{V_0}{c r_p}\frac{q^2}{r^2} = \frac{V_0}{c r_p}\frac{m_p m_p}{(k s_p \rho_0)^2 r^2} \approx \left(\frac{4\alpha c r_p}{\pi^2 d V_0 \rho_0^2}\right)\frac{m_p m_p}{r^2} = \left(\frac{V_0 \alpha c^2 r_p}{\hbar}\right)\frac{m_p m_p}{r^2} = G\frac{m_p m_p}{r^2}$$

where $G = V_0\alpha c^2 r_p/\hbar$ is the gravitational constant expressed through the parameters of the ether, and the fine structure constant $\alpha \approx (4a+\pi)^2/4\pi^4 d = 0.0073128$The electrostatic field of the neutron is zero, however, the gravitational field of the neutron is nonzero and directed toward the center of the neutron, like the proton field. Since the neutron mass is 1.0013 times greater than the proton mass, it can be assumed that the gravitational field of the neutron is the same number of times greater than the gravitational field of the proton. The presence of electrons, the number of which is equal to the number of protons in the atomic nucleus, slightly reduces the gravitational field of protons and neutrons. Since the mass of any material body is equal to the sum of the masses of the atoms of the chemical elements that make up the body, minus their binding energies (masses), and the mass of each atom is equal to the sum of the masses of the protons and neutrons of the atomic nucleus and the electrons of the electron shell of the atom, minus their binding energies (masses), then the mass m of any material body is also proportional to the product $q\rho_0$, that is, $m = k_m q\rho_0$. Consequently, we can draw the important conclusion that for any mass m there exists a charge δ in units of elementary charge $\delta = k_m q$, such that $m = \delta\rho_0$.

Thus, formally, the forces of gravitational interaction between masses satisfy the law of universal gravitation. However, gravitational fields, like electrostatic fields, are radially averaged, stationary fields. Gravitational interactions between bodies do not propagate from one body to another at a specific velocity, but at any given moment, stationary gravitational fields of anybody exist alongside and around them. Therefore, neither gravitational waves nor gravitons exist in nature. Gravitational fields, as Newton hypothesized, are created by elementary particles of matter and are a consequence of small periodic changes in the ether density in the surrounding space with stationary distributions of radial velocities and averaged intensities of these changes. Gravitational forces act between any bodies and are directed toward the bodies that create the gravitational fields. This is explained by the presence of protons and neutrons with gravitational fields directed toward the particle centers, and the negligible gravitational fields of electrons, which are directed away from the particle centers. Therefore, the physical meaning of the law of universal gravitation lies not in the attraction of bodies, but in the pressing bodies each to other by gravitational fields in the ether, which Newton considered entirely possible. However, the repulsive forces of electrons are negligible compared to the pressing down forces of protons and neutrons. And the different values of the gravitational constant are determined not by the poor accuracy of the experiments, but by the different chemical compositions of the material bodies involved in the experiments, that is, by the different numbers of electrons, which reduce the magnitude of the gravitational field. Substituting the experimental values of Planck's constant $\hbar = 1.0546 \cdot 10^{-27} cm^2 \cdot g \cdot s^{-1}$, the fine structure constant $\alpha = 0.0072974$, the gravitational constant $G = 6.6757 \cdot 10^{-8} cm^3 \cdot g^{-1} \cdot s^{-2}$ with overlapping confidence intervals of its experimental values, and the proton radius $r_p = 2.103 \cdot 10^{-14} cm$ into the ether formulas for Planck's constant and the gravitational constant, we unambiguously find that

$$V_0 = 5.10438 \cdot 10^{-40} cm^2 s^{-1}, \quad \rho_0 = 1.06345 \cdot 10^{20} cm^{-3/2} \cdot g^{1/2} \cdot s.$$

In this case, the condition $V_0/r_p = 2.427 \cdot 10^{-26} cm \cdot s^{-1} \ll 1$ is actually fulfilled, that is, all mathematical approximations and linearizations used in the theory of compressible oscillating ether are legal. In this case, the value of the elementary charge is equal to

$$q = \rho_0 c V_0 (4a + \pi)/4\pi = 0.29547\, \rho_0 c V_0 = 4.812 \cdot 10^{-10} cm^{3/2} \cdot g^{1/2} \cdot s^{-1},$$

and the proton internal mass (rest mass) is equal to

$$m_p = \frac{\pi^3 d}{(4a + \pi)} \frac{V_0}{c r_p} q\rho_0 = \frac{\hbar}{c r_p} = \frac{\hbar \omega_p}{c^2} = \frac{1.0546 \cdot 10^{-27} cm^2 \cdot g \cdot s^{-1},}{3 \cdot 10^{10} cm \cdot s^{-1} \cdot 2.103 \cdot 10^{-14} cm} = 1.6716 \cdot 10^{-24} g.$$

The internal mass (rest mass) of an electron is $9.105 \cdot 10^{-28}$g. The gravitational field of a proton is in $c r_p / V_0 = 1.235 \cdot 10^{36}$ times smaller than its electrostatic field, and the gravitational field of an electron is in $c r_e / V_0 = 2.267 \cdot 10^{39}$ times smaller than its electrostatic field.

Newton's First Law (law of inertia)

Newton's first law, known as the law of inertia, states the property of a body to maintain a state of rest or uniform motion in a straight line when no forces act upon it. Newton believed that inertial forces, like any other forces acting on material bodies moving through the ether, depend on the masses of the bodies but are independent of the speed, shape, and cross-sectional area of the bodies, as well as the density of the medium in which the bodies move. In modern physics, this law is an axiom based on a generalization of experimental results and is believed to be valid only in so-called inertial reference frames and applies not to bodies, but to point objects. In the theory of compressible oscillating ether, this law is a consequence of the equations of the ether. Indeed, let a body of mass m move through the ether with velocity $\mathbf{u}$. A charge δ corresponds to the mass m of the body such that $m = \delta\rho_0$. Since $\rho = \rho_0(1 + g(r,\theta,\xi))$, $|g| \ll 1$, then expression (8) for the force acting on a charge δ

moving in the ether with a velocity **u** can be rewritten in the form

$$\mathbf{F} = \delta\left(\mathbf{E} + \frac{\mathbf{u}}{c} \times \mathbf{B}\right) = \delta(|\mathbf{u}|\nabla(\rho|\mathbf{u}|)) \approx \delta\rho_0(|\mathbf{u}|\nabla(|\mathbf{u}|)) = \mathrm{m}(|\mathbf{u}|\nabla(|\mathbf{u}|)).$$

We can now express the resistance force of the ether to a mass m moving in it at a speed u in the form

$$\mathbf{F} = \mathrm{m}(|\mathbf{u}|\nabla(|\mathbf{u}|)). \quad (10)$$

During uniform rectilinear motion, and in particular at rest, $|\mathbf{u}|$ = const and is independent of spatial variables. In this case, $\nabla|\mathbf{u}| = 0$. Consequently, $\mathbf{F} = 0$, that is, the ether's resistance to uniform rectilinear motion is zero. The body will maintain such motion until acted upon by other forces. If, however, the body is acted upon by some non-zero external force $\mathbf{F} \neq 0$, then the gradient $\nabla|\mathbf{u}|$ cannot be zero, since in that case the force would be zero. Consequently, in this case $\nabla|\mathbf{u}| \neq 0$, meaning the magnitude of the velocity or its direction must change, and the motion cannot be uniform and rectilinear. Thus, in the theory of compressible oscillating ether, inertial forces are real forces acting on the body from the ether and impeding a change in its uniform and rectilinear motion. According to formula (10), the ether does not resist the body during its uniform and rectilinear motion. This is not an axiom, but a property of the etheric medium, following from its equations.

Newton's Second Law (law of Motion)

Naturally, the question arises as to what form the forces acting on bodies moving in the ether have, and what they depend on, when the magnitude or direction of the velocity of motion is inconstant, that is, when motion is accelerated or decelerated. Newton divided these forces into two groups: forces acting on bodies and causing them to move, and the inertial forces of the ether, which counteract such motion. Newton believed that any forces causing a body to move are proportional to the mass of the body and the change in velocity. Newton formulated the latter statement as a law of mechanical motion, which is now known as Newton's second law. In its modern formulation, Newton's second law is an axiom and postulates that in inertial frames of reference, the acceleration acquired by a material point is directly proportional to the resultant of all forces applied to the point, coincides with it in direction, and is inversely proportional to the mass of the material point. Newton himself gives the following formulation of his law: "The change in the momentum is proportional to the motive force applied, and occurs in the direction of the line along which this force acts." In Newton's formulation, we are talking about a body with a certain mass, and, therefore, the second law has the form $\mathbf{F} = m\mathbf{a}$. We will show that Newton's second law is also a consequence of the equations of the ether, namely, a consequence of equation(10). Indeed, we rewrite expression (10) for the force acting on a mass m, as

$$\mathbf{F} = m\left(u_x\frac{\partial u_x}{\partial x}\mathrm{i}_x + u_y\frac{\partial u_y}{\partial y}\mathrm{i}_y + u_z\frac{\partial u_z}{\partial z}\mathrm{i}_z\right) = m\left(\frac{\partial u_x}{\partial x}\frac{dx}{dt}\mathrm{i}_x + \frac{\partial u_y}{\partial y}\frac{dy}{dt}\mathrm{i}_y + \frac{\partial u_z}{\partial z}\frac{dz}{dt}\mathrm{i}_z\right)$$

Hence,

$$\mathbf{F} = m\frac{d\mathbf{u}}{dt} = m\mathbf{a}. \quad (11)$$

That is, any force $\mathbf{F}$ acting in the ether on a body of mass m causes it to move with acceleration $\mathbf{a}$. Conversely, if a body moves in the ether with acceleration $\mathbf{a}$, then the etheric resistance force acting on it is $\mathbf{F} = -m\mathbf{a}$.

Corollary 1. During rectilinear motion of a body of mass m with acceleration $\mathbf{a}$, the force causing the acceleration is $\mathbf{F} = \mathrm{m}\mathbf{a}$. This creates a counterforce of the ether acting on the body but directed opposite to its acceleration. When the car accelerates, the force of inertia presses the passengers into their seats, and when braking, it pushes them forward from the seatback.

Corollary 2. Centrifugal force of inertia. Consider the rotation of a ball of mass m along a circle of radius R about a point **O** with an angular velocity ω. The rope to which the ball is tied acts on it with a centripetal force

$\mathbf{F}_{cp} = -m\omega^2\mathbf{R}$, directed toward the center of rotation (Fig.1).

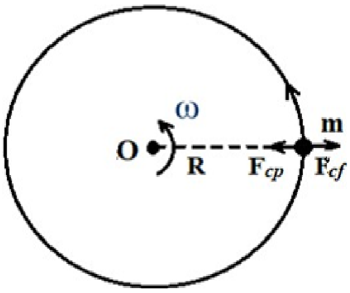

Figure 1: Movement of the ball in a circle.

Obviously, there must be another force acting on the ball, directed in the direction opposite to the centripetal force and equal to it in magnitude. This is the centrifugal force of inertia $\mathbf{F}_{cf}$, , the source of which is unknown to modern science. According to modern scientific concepts, centrifugal forces of inertia arise during the transition from an inertial to a non-inertial frame of reference and disappear during the reverse transition. The reason for this absurd understanding of centrifugal force is that modern physics denies the existence of the ether. We will show that the ether drag force (10) during rotational motion is precisely this centrifugal force. Indeed, let us substitute into formula (10) the magnitude of the linear rotation speed modulus |u|= ωR. Then

$$\mathbf{F}_{cf} = \mathrm{m}(\omega^2 \mathrm{R}\nabla(\mathrm{R})) = \mathrm{m}(\omega^2 R\mathbf{R}/\mathrm{R}) = m\omega^2\mathbf{R}.$$

That is, the centrifugal force $\mathbf{F}_{cf}$ is applied to the ball, is equal in magnitude to the centripetal force $\mathbf{F}_{cp}$ and is directed in the opposite direction perpendicular to the direction of the velocity vector of movement in full accordance with Newton's third law. This does not require the introduction of any non-inertial reference frames. There is one absolute Newtonian reference frame, associated with absolute time and absolute space, filled with a globally stationary, oscillating ether. Newton's laws operate in this frame, and the inertial forces are the forces of resistance of the ether to changes in the uniform and rectilinear motion of bodies.

Newton's Third Law (The Law of Equal Action and Reaction)

Newton formulated his third law of mechanics as follows: "To every action there is an equal and opposite reaction: that is, the mutual repulsion of two bodies is equal and opposite." In its modern formulation, Newton's third law is also an axiom and postulates that the forces of interaction between two material points are equal in magnitude, opposite in direction, and act along a straight line connecting these material points. Here, as in the other two laws, we are also talking about material points, not bodies, as was the case with Newton. We will show that Newton's third law is a consequence of the equations of the theory of compressible oscillating ether, namely, a consequence of the fact that any interaction between two bodies in the ether, other than a collision, occurs through the action of the field created in the ether by one body on the other body, and vice versa. Moreover, all fields in the ether (Coulomb, electromagnetic, gravitational) are created by the charges or masses of elementary particles of matter (protons, electrons, neutrons). For the Coulomb and gravitational fields, this follows from formulas (9). The situation is more complex with the electromagnetic field, since historically, when currents interact, it has been customary to consider their interactions only through their magnetic fields, neglecting their electrical components. This is the essence of Ampere's law of interaction between currents and their magnetic fields, which implies that Newton's third law for currents should not hold. However, if we return to the formula for the total force interaction of moving charges, determined by the Lorentz formula, Newton's third law will also hold, since the Lorentz formula determines the total force with which the electromagnetic field created by one charge acts on another charge.

Conclusion

- Unlike modern physical theories, in the theory of compressible oscillating ether, inertial forces are real forces acting on a body from the ether and resisting changes in its state of rest or uniform and rectilinear motion.
- Ether exists and is probably described by the formulas of the theory of compressible oscillating ether,

since all the laws of electrodynamics, all the properties of elementary particles of matter, the properties of atoms and atomic nucleu, the periodicity of the properties of chemical elements and all of Newton's laws, which for more than 300 years were considered axioms that did not follow from other physical theories, are derived from them.

- The results obtained fully confirm Newton's correctness in that space is absolutely three-dimensional, Euclidean, and filled with immaterial ether; time is absolute; non-inertial reference frames do not exist; the source of gravity is the mass of the body, that is, what the body consists of; and gravity itself is not an attraction, but a pressing bodies toward each other.

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