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Fundamentals of the theory of compressible oscillating ether

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Abstract. In the paper, ether is considered as a dense compressible inviscid oscillating medium in three-dimensional Euclidean space, having a density of ether and a velocity vector of propagation of density perturbations at each instant of time. Ether can be described by two nonlinear equations, where the first equation is the continuity equation, and the second is the ether momentum conservation law. It is shown that the consequences of the system of these two equations are: a generalized nonlinear system of Maxwell-Lorentz equations that is invariant under Galileo transformations, the linearization of which leads to the classical system of Maxwell-Lorentz equations; Coulomb law; representations for Planck's and fine structure constants; formulas for the electron, proton and neutron in the form of wave solutions of the system of two ether equations for which the calculated values of their internal energies, masses and magnetic moments coincide, with an accuracy to fractions of a percent, with their experimental values, anomalous from the point of view of modern physics.

1. Introduction

It is well known that the main reason for the emergence of a special theory of relativity in the early twentieth century were the contradictions between electrodynamics, described by Maxwell's equations, and classical mechanics obeying equations and Newton's laws. It turned out that the basic laws of electrodynamics at transition from one inertial reference system to another remain invariant with respect to the Lorentz transformations, in contrast to the laws of mechanics, which remain invariant with respect to the Galileo transformations. It was necessary to choose between the following two possibilities: a) either recognize that Maxwell's linear equations are not entirely correct and they need to be generalized in such a way that they satisfy Galileo transformations; b) either recognize that the equations of the classical mechanics are not entirely correct and they should be considered only as approximations to the true Maxwell's equations satisfying Lorentz transformations.

World science chose the second option, despite the reasoned objections of many prominent scientists of the beginning of the last century. The path chosen by the world science led to the absolutization of the speed of light and Maxwell's equations, which led to a complete cessation studies in the search for more general equations of electrodynamics, satisfying Galileo relativity principle. Such equations, in the opinion of the author, was derived in [1-3], starting from the unique postulate of the existence of an ether in the form of a dense compressible inviscid oscillating medium in three-dimensional Euclidean space with coordinates $\mathbf{r}(t)$, having in each moment of time t the density $\rho(t,\mathbf{r})$ and the velocity vector of the density perturbations $\mathbf{u}(t,\mathbf{r})$. In [1-3], the ether medium is proposed to be described in three-dimensional Euclidean space by two nonlinear equations, following from the equations of classical Newtonian mechanics:

$$\frac{\partial \rho}{\partial t} + div(\rho\,\mathbf{u}) = 0,\ \ \frac{d(\rho\,\mathbf{u})}{d\,t} = \frac{\partial(\rho\,\mathbf{u})}{\partial\,t} + (\mathbf{u}\cdot\nabla)(\rho\,\mathbf{u}) = 0, \tag{1.1}$$

where the first equation is the continuity equation, and the second is the ether momentum conservation law. In the present paper, a complete generalized nonlinear system of Maxwell-Lorentz equations that is invariant under Galileo transformations is derived from the system of the ether equations (1.1), the linearization of which leads to the classical system of Maxwell-Lorentz equations. This proves the existence of the first possibility of the emergence of the science from the crisis in the beginning of the last century. In addition the representations for Planck's and fine structure constants are received; formulas for electron, proton and neutron are derived in the form of wave solutions of the system of two ether equations (1.1) for which the calculated values of their internal energies, masses and magnetic moments coincide, with an accuracy to fractions of a percent, with their experimental values, anomalous from the point of view of the modern physics.

2. Derivation of the system of Maxwell-Lorentz equations

Ethereal definitions of the vectors of electric field intensity **E** and magnetic field induction **B** are given in [1-3]:

$$\mathbf{B} \equiv c\nabla\times(\rho\mathbf{u}), \tag{2.1}$$

$$\mathbf{E} \equiv (\mathbf{u}\cdot\nabla)(\rho\mathbf{u}) = \frac{1}{\rho}(\rho\mathbf{u}\cdot\nabla)(\rho\mathbf{u}) = \frac{1}{\rho}(\frac{1}{2}\nabla(\rho\mathbf{u})^2 - \rho\mathbf{u}\times(\nabla\times(\rho\mathbf{u}))) = |\mathbf{u}|\nabla(\rho|\mathbf{u}|) - \frac{\mathbf{u}}{c}\times\mathbf{B}, \tag{2.2}$$

where the positive constant c is the velocity of free propagation of the perturbations in ether (speed of light). The representation of the flux density of the ether $\rho\mathbf{u}$ in the form (2.1) - (2.2) is some special decomposition of it into two vectors **E** and **B**. Let us show that the vectors **E** and **B** introduced in this way satisfy equations that can be interpreted as generalized Maxwell-Lorentz equations.

2.1. Derivation of nonlinear generalized system of Maxwell-Lorentz equations

It follows from (2.2) that

$$\mathbf{E} + \frac{\mathbf{u}}{c}\times\mathbf{B} = |\mathbf{u}|\nabla(\rho|\mathbf{u}|). \tag{2.3}$$

The left-hand side of (2.3) is the field corresponding to the Lorentz force, and the right-hand side is the representation of the force action of the ether through its density and velocity of density perturbations. Therefore, equation (2.3) can be interpreted as a representation of the force arising under perturbations of the ether, through **E** and **B.**

Let us apply the operator $c\nabla\times$ to the second equation from (1.1). We get

$$\frac{\partial\mathbf{B}}{\partial\,t} + c\nabla\times\mathbf{E} = 0. \tag{2.4}$$

Taking the divergence from (2.1) and (2.2), we obtain

$$\nabla\cdot\mathbf{B} = 0, \tag{2.5}$$

$$\nabla\cdot\mathbf{E} = 4\pi\sigma,\quad 4\pi\sigma \equiv \nabla\cdot(\frac{1}{\rho}(\rho\mathbf{u}\cdot\nabla)(\rho\mathbf{u})) = \nabla\cdot(|\mathbf{u}|\nabla(\rho|\mathbf{u}|)) - \nabla\cdot(\mathbf{u}\times(\nabla\times(\rho\mathbf{u}))), \tag{2.6}$$

where σ has the meaning of the charge density, determined by perturbations of the ether density.

Let us apply the derivative operator along the curve $(\mathbf{u}\cdot\nabla)$ to the second equation from (1.1):

$$\frac{\partial\mathbf{E}}{\partial\,t} - \nabla\times(\frac{|\mathbf{u}|^2}{c}\mathbf{B}) + 4\pi\,\mathbf{j} = 0, \tag{2.7}$$

where **j** has the meaning of a vector of electric current density and

$$4\pi\,\mathbf{j} \equiv (\mathbf{b}\cdot\nabla)\mathbf{u} + \mathbf{u}(\nabla\cdot\mathbf{b}) - \mathbf{b}(\nabla\cdot\mathbf{u}) - \nabla\times(\mathbf{u}\times(\nabla(\mathbf{u}\cdot\mathbf{a}) - (\mathbf{a}\cdot\nabla)\mathbf{u} - \mathbf{a}\times(\nabla\times\mathbf{u}))) + \nabla\times(\mathbf{u}(\mathbf{u}\cdot(\nabla\times\mathbf{a}))) -$$
$$-(((\nabla\cdot\mathbf{u})\mathbf{u} - (\mathbf{u}\cdot\nabla)\mathbf{u})\cdot\nabla)\mathbf{a}, \qquad \mathbf{a}\equiv\rho\,\mathbf{u}, \qquad \mathbf{b}\equiv(\mathbf{u}\cdot\nabla)\mathbf{a} = (\nabla|\mathbf{a}|^2/2 - \mathbf{a}\times(\nabla\times\mathbf{a}))/\rho.$$

In deriving equation (2.7), we use the known rules of action with the operator ∇:

$$(\mathbf{u}\cdot\nabla)((\mathbf{u}\cdot\nabla)(\rho\,\mathbf{u})) = (\mathbf{u}\cdot\nabla)\mathbf{b} = (\mathbf{b}\cdot\nabla)\mathbf{u} + \mathbf{u}(\nabla\cdot\mathbf{b}) - \mathbf{b}(\nabla\cdot\mathbf{u}) - \nabla\times(\mathbf{u}\times\mathbf{b}),$$
$$\mathbf{u}\times\mathbf{b} = \mathbf{u}\times((\mathbf{u}\cdot\nabla)\mathbf{a}) = \mathbf{u}\times(\nabla(\mathbf{u}\cdot\mathbf{a}) - (\mathbf{a}\cdot\nabla)\mathbf{u} - \mathbf{a}\times(\nabla\times\mathbf{u})) - \mathbf{u}\times(\mathbf{u}\times(\nabla\times\mathbf{a})),$$

expression for a double vector product

$$\mathbf{u}\times(\mathbf{u}\times(\nabla\times\mathbf{a})) = \mathbf{u}(\mathbf{u}\cdot(\nabla\times\mathbf{a})) - (\mathbf{u}\cdot\mathbf{u})\nabla\times\mathbf{a}$$

and formula (3) from [4]:

$$\partial\mathbf{u}/\partial t = (\nabla\cdot\mathbf{u})\mathbf{u} - (\mathbf{u}\cdot\nabla)\mathbf{u}.$$

As a result, we obtain a nonlinear, generalized system of Maxwell equations that is invariant under Galileo transformations in the same way as the initial system of ether equations (1.1):

$$\nabla\times\mathbf{E} = -\frac{1}{c}\frac{\partial\mathbf{B}}{\partial t}, \quad \nabla\times\left(\frac{|\mathbf{u}|^2}{c^2}\mathbf{B}\right) = \frac{1}{c}\frac{\partial\mathbf{E}}{\partial t} + \frac{4\pi\,\mathbf{j}}{c}, \quad \nabla\cdot\mathbf{B} = 0, \quad \nabla\cdot\mathbf{E} = 4\pi\sigma. \qquad (2.8)$$

Taking the divergence from the equation (2.7), we obtain the law of conservation of charge

$$\partial\sigma/\partial t + (\nabla\cdot\mathbf{j}) = 0.$$

Equation (2.3) multiplied by the charge density, goes into the density of the Lorentz force $\mathbf{F}_L$:

$$\mathbf{F}_L = \sigma(\mathbf{E} + \frac{\mathbf{u}}{\mathbf{c}}\times\mathbf{B}). \qquad (2.9)$$

Thus, the systems of nonlinear equations (1.1),(2.1)-(2.3) or (2.8)-(2.9), where the unknown functions are functions ρ, **u**, **E**, **B**, can be interpreted as a system of generalized Maxwell-Lorentz equations.

2.2. Derivation of the linear system of Maxwell equations

In the case $|\mathbf{u}| \approx c$ and experimentally determined σ and **j**, equations (2.8) go over into the classical linear system of Maxwell equations

$$\nabla\times\mathbf{E} = -\frac{1}{c}\frac{\partial\mathbf{B}}{\partial t}, \quad \nabla\times\mathbf{B} = \frac{1}{c}\frac{\partial\mathbf{E}}{\partial t} + \frac{4\pi\,\mathbf{j}}{c}, \quad \nabla\cdot\mathbf{B} = 0, \quad \nabla\cdot\mathbf{E} = 4\pi\sigma. \qquad (2.10)$$

According to [5], the introduction of dielectric and magnetic permeability of the medium is not necessary. All effects of the medium are in σ and **j**.

It is important to note once again that the initial nonlinear equations of the ether (1.1) are invariant with respect to Galileo transformations [2]. The reason for the loss of such invariance in Maxwell's equations is the linearization of the ether equations (equations (2.7)) for $|\mathbf{u}| \approx c$. Expressions for σ and **j** in terms of the ether density and velocity of perturbations make it possible to calculate σ and **j** theoretically. With the help of specially excited ether motions, it is possible to obtain a density ρ and a velocity **u** in a vacuum (that is, in the presence of an ether medium and the absence of material objects in it) corresponding to the electric current and charge density. Moreover, the presence of charge carriers and current carriers themselves, for example elementary particles, is not necessary.

We give the simplest example of the solution of Maxwell's generalized equations. Equations of the ether (1.1) are satisfied by the density $\rho = const$ and the vector velocity

$$\mathbf{u} = u_a\cos(\omega t - \frac{\omega z}{c})\mathbf{i}_x + u_a\sin(\omega t - \frac{\omega z}{c})\mathbf{i}_y + c\mathbf{i}_z, \qquad (2.11)$$

where u_α is the amplitude of the transverse velocity. This is a helical wave of ether. According to formulas (2.1), (2.2) such velocity and density of the ether correspond to a plane monochromatic circularly polarized electromagnetic wave. It is known that such a wave satisfies the classical Maxwell equations (2.10). The advantage of the ether representation of electromagnetic waves is the presence in an explicit form of the longitudinal velocity component in the direction of wave propagation in addition to the transverse oscillating component. Due to differentiation, in the vectors **E** and **B**, there are no components in the direction of wave propagation, which causes difficulties in interpretation of experimental information on the motion of waves. In addition, energy during the motion of the helical wave of the ether is preserved in contrast to the sin-phase electromagnetic wave, the energy of which must periodically be equal to zero.

The vectors **E** and **B** can be measured, so the inverse problem of finding ρ and **u** for the given **E** and **B** is of interest. One can solve this problem, for example, by defining a vector $\rho\mathbf{u}$ from equation (2.1) and substituting it into equations (1.1) for calculation ρ. The vector $\mathbf{A} = c\rho\mathbf{u}$ is a vector potential, since, according to (2.1), $\mathbf{B} = \nabla\times\mathbf{A}.$

2.3. Difference of the ether equations from the equations of mechanics of continuous medium

Let us briefly consider the differences between the system of ether equations (1.1) and the classical equations of mechanics of continuous medium. In the classical mechanics of continuous medium, the continuity equation has the same form as the first equation from the system of equations (1.1). However, the equation of motion is different. In the classical mechanics of continuous medium, on the basis of the law of conservation of momentum in integral form and formula of the time-differentiation for the integral by moving volume [5, p. 37], that is, differentiating the volume integral, depending on the parameter, the following equation is derived

$$\rho(t,\mathbf{r})\frac{d\mathbf{u}(t,\mathbf{r})}{dt} = \mathbf{F}(t,\mathbf{r}) + (\nabla_{\mathbf{r}}\, p(t,\mathbf{r}))_{\mathbf{r}=\mathbf{r}(t)}. \tag{2.12}$$

Thus, the formal difference of the equation of motion of the ether (second equation in (1.1)) from the equation of motion of classical mechanics of continuous medium (2.12), including gas and hydrodynamics, consists in the absence of forces and a pressure gradient in the right-hand side of the second equation in (1.1), and in the presence of the power term $\mathbf{u}(t,\mathbf{r})\,d\rho(t,\mathbf{r})/dt$ in its left-hand side.

The first difference is explained by the fact that the ether, as the first-born environment, itself forms the forces and pressure acting on the material objects generated by it. The second difference is due solely to the fact that there is no movement of the ether as a continuous medium, and only perturbations of its density move with conservation of the magnitude of the elementary volume in the propagation of these perturbations. Consequently, the locally oscillating compressible ether is globally stationary, forming an absolute fixed coordinate system in three-dimensional Euclidean space. All movements in the ether, including the movement of material objects, are movements of oscillations and perturbations of its density. The effect of changing the ether density in time $d\rho(t,\mathbf{r})/dt$ in the equation of motion (second equation in (1.1)) plays an important role, in particular, determines the presence of electric charge, magnetic moment and mass of elementary particles (see below). In addition, unlike equation (2.12), it is precisely from the equations of motion in (1.1) the Maxwell's equations and many other facts known from experiments, such as the laws of Coulomb, Ampere, Bio-Savart-Laplace, the structure of the hydrogen atom, etc., follow immediately [1-4, 6-8].

3. Wave nature of matter

In this section the basic structural units of matter: proton, electron and neutron are presented by solutions of the ether system (1.1). The formulas of their charges, energy, mass and values of their magnetic moments are found, which coincide with the experimental "anomalous" values to within a fraction of a percentage. In addition, formulas for the Planck constant and the fine structure constant are obtained from the system of ether equations. The mechanism of production of the particle and antiparticle from the photon of twice energy and the mechanism of particle annihilation are described. The meaning and purpose of neutrons in the nuclei of atoms of chemical elements is clarified.

3.1. Ethereal models of electron and proton

Electron and proton are truly elementary particles that make up matter. These particles together with their antiparticles (positron and antiproton) are born from photons and are annihilate to form photons. In addition, they have the same absolute charge. Therefore, they should have a similar structure and a single mechanism of birth from the ether, that is described by the system of equations (1.1).

3.1.1. The system of equations of elementary particles. Transition in the system of equations (1.1) to a stationary spherical system of coordinates and consideration only those solutions of the resulting system of equations in which a component V_θ of the velocity vector $\mathbf{u}=(V_r,V_\theta,V_\varphi)=(V,0,W)$ of propagation of ether perturbations along the radius *r* and the angles (θ,φ) is zero leads to a system of equations for elementary particles:

$$\begin{aligned}
&\frac{\partial\rho}{\partial t}+\frac{1}{r^2}\frac{\partial(r^2\rho V)}{\partial r}+\frac{1}{r\sin\theta}\frac{\partial(\rho W)}{\partial\varphi}=0,\\
&\frac{\partial(\rho V)}{\partial t}+V\frac{\partial(\rho V)}{\partial r}+\frac{W}{r\sin\theta}\frac{\partial(\rho V)}{\partial\varphi}=0, \qquad (\mathbf{r})\\
&\frac{\partial(\rho W)}{\partial t}+V\frac{\partial(\rho W)}{\partial r}+\frac{W}{r\sin\theta}\frac{\partial(\rho W)}{\partial\varphi}=0, \qquad (\boldsymbol{\varphi})
\end{aligned} \tag{3.1}$$

In parentheses after lines of equations of the system (3.1) the unit coordinate vectors are shown in which directions the vectors of corresponding rows are directed.

Let us find the solutions of the system of equations (3.1), which have for small r all the known properties of the basic elementary particles. These solutions will be sought in the form of waves propagating along angle φ around the axis z with constant angular velocity $\omega=c/r_0$ under the influence of small oscillations of the ether density: $W=\omega r\sin\theta$, $\rho(r,\theta,\varphi,t)=\rho_0(1+g(r,\theta,\varphi,t))$, $|g|<<1$. We assume that the radial component $V(r,\theta,\varphi,t)$ of the velocity of propagation of ether density perturbations is also small for small *r*. In this formulation, each elementary particle is a ball of radius r_0, within which along each parallel (circle of radius $r\sin\theta$, $r\le r_0$) as a result of small radial oscillations of the ether density the waves propagate with constant angular velocity (frequency) $\omega=c/r_0$, performing a full crawl of the parallel along the corner $0\le\varphi\le 2\pi$ at the same time $T=2\pi r\sin\theta/W=2\pi r_0/c=2\pi/\omega$.. And the linear velocity of these waves increases linearly with increasing radius, reaching its maximum value (the speed of light c) on the equator of the ball at $r=r_0$, $\sin\theta=1$. Outside the particle, i.e. when $r>r_0$ we set $W=c\sin\theta$. Substituting the expected form of the solutions to the system (3.1) and neglecting terms of the second order and the products of small terms, in particular, strongly nonlinear second-order term $V\,\partial(\rho V)/\partial r\,\mathbf{r}$, which produces the gravitational field of the particle, we obtain a linearized system of equations

$$\frac{\partial g}{\partial t}+\frac{\partial V}{\partial r}+\frac{2V}{r}+\omega\frac{\partial g}{\partial\varphi}=0,\quad \frac{\partial V}{\partial t}+\omega\frac{\partial V}{\partial\varphi}=0,\ (\mathbf{r})\ ,\quad \frac{\partial g}{\partial t}+V/r+\omega\frac{\partial g}{\partial\varphi}=0.\quad (\boldsymbol{\varphi}) \tag{3.2}$$

3.1.2. Rolled photon. We represent by the following way the formation of particle and antiparticle from a helical wave of photon, having a frequency 2ω **.** First, the photon is compressed to the form of a wave structure of periodic compressions and tensions of ether density in the radial direction inside the sphere of radius $r_{ph}=c/2\omega$, moving with an angular velocity 2ω along the angle φ inside the ball, which length of the equator of the sphere is equal to the Compton wavelength of the photon

$\lambda_c = 2\pi r_{ph}$. Such a wave passes an angle 2π during the time $T = \pi / \omega$ for any $r < r_{ph}$. This process is described by solutions of the system of equations (3.2) of the form:

$$V(r,\theta,\varphi,t) \approx \frac{V(\theta)\cos(\omega t - \varphi/2)}{r}, \qquad \frac{d\varphi}{dt} = 2\omega,$$

$$g(r,\theta,\varphi,t) \approx -\frac{V(\theta)\varphi\cos(\omega t - \varphi/2)}{r^2(2\omega)}, \quad W = (2\omega) r \sin\theta.$$

Solutions of the system of ether equations of the last form is a rolled photon. It will be shown that the charge and magnetic moment of the rolled photon is zero, and its energy is $\hbar(2\omega)$, where $\hbar$ is the Planck constant. Then the period-doubling bifurcation of the rolled photon takes place while maintaining its energy. As a result, a rolled photon of double period is produced, described by the solutions of the system of equations (3.2) of the form:

$$V(r,\theta,\varphi,t) \approx \frac{V(\theta)\cos((\omega t - \varphi)/2)}{r}, \qquad \frac{d\varphi}{dt} = \omega,$$

$$g(r,\theta,\varphi,t) \approx -\frac{V(\theta)\varphi\cos((\omega t - \varphi)/2)}{r^2\omega}, \quad W = \omega r \sin\theta.$$

The wave of radial oscillations of the ether density in a rolled photon of the doubled period moves along the angle φ with the angular velocity ω inside the sphere of radius $r_0 = c/\omega$. In this case, small periodic radial compressions and expansions of the ball of the rolled photon occur with the average ether density in it equal to ρ_0. Define traditionally the density distribution of the electric field intensity and the density distribution of the electric charge of a rolled photon of double period

$$\mathbf{E} = E\,\mathbf{r} = \frac{W}{r\sin\theta}\frac{\partial(\rho V)}{\partial\varphi}\mathbf{r}, \qquad \delta = \frac{1}{4\pi} div\,(V\frac{\partial(\rho W)}{\partial r}\boldsymbol{\varphi}). \tag{3.3}$$

As $\partial V(r,\theta,\varphi,t)/\partial\varphi \approx V(\theta)\sin((\omega t - \varphi)/2)/2r$, then the density distribution of the electric charge of a rolled photon of double period is determined in the first approximation by the expression

$$\delta_0(r,\theta,\xi) = \delta_0(r,\theta,\omega t - \varphi) = \frac{\rho_0\omega}{8\pi r^2}V(\theta)\sin((\omega t - \varphi)/2). \tag{3.4}$$

3.1.3. Charges of elementary particles. The charge density wave (3.4) can be represented as the sum of two half-waves

$$\delta_+(r,\theta,\xi) = \frac{\rho_0\omega}{8\pi r^2}V(\theta)\sin\xi/2, \quad 0 \le \xi < 2\pi, \qquad \delta_-(r,\theta,\xi) = \frac{\rho_0\omega}{8\pi r^2}V(\theta)\sin\xi/2, \quad -2\pi \le \xi < 0,$$

bearing only positive or only negative charges. It is not difficult to see that the positive charge wave corresponds exclusively to a periodic expansion of the volume of the particle in comparison with the average volume occupied by a rolled photon of the double period, with a periodic small increase in the radius of the particle. In this case, the average density of the ether inside the particle is less than the density of its unperturbed state ρ_0. Similarly, the negative charge wave corresponds exclusively to the periodic compression of the volume of the particle in comparison with the average volume occupied by the rolled photon of the double period, with a periodic small decrease in the radius of the particle. In this case, the average density of the ether inside the particle is greater than the density of its unperturbed state. Integrating the charge distribution density for the positive and negative half-waves inside the sphere of radius r_0, we find the charges that have a particle and an antiparticle in the form:

$$
\begin{aligned}
q_{\pm} &= \pm\int_0^{\pi}\int_0^{2\pi}\int_0^{r_0} \frac{\rho_0 \omega V(\theta)}{8\pi r^2}\sin(\xi/2) r^2 \sin\theta \; dr d\xi d\theta = \pm\frac{\rho_0 \omega r_0 V_q}{8\pi}\int_0^{2\pi}\sin(\xi/2)d\xi \\
&= \pm\frac{\rho_0 \omega r_0 V_q}{2\pi} = \pm\frac{\rho_0 c V_q}{2\pi}; \qquad V_q = \int_0^{\pi} V(\theta)\sin\theta \, d\theta .
\end{aligned} \tag{3.5}
$$

The functions for electron (positron) and proton (antiproton) in formulas (3.4) - (3.5) will be sought in the form of an expansion in a series in the angle θ :

$$V_{e,p}(\theta) = V_0(a + \sin\theta \pm b\sin 2\theta + c_{e,p}\sin 3\theta), \tag{3.6}$$

where constants a, b, c_p, c_e will be defined below. Substituting expressions (3.6) in (3.5), we obtain the law of universality of charge

$$|q_e| = |q_p| = \frac{\rho_0 c}{2\pi} V_0 \int_0^{\pi} (\mathrm{a}\sin\theta + \sin^2\theta) d\theta = \frac{\rho_0 c V_0}{4}(1 + \frac{4a}{\pi}) = q. \tag{3.7}$$

At the same time, the charge of any rolled photon of the double period is equal to zero. In (3.7) dimensional constants V_0, ρ_0, c are the parameters of the world ether, through which all other physical constants can be expressed with the preservation of their dimensions in the CGS system.

3.1.4. Electric fields. Outside the volume of the ball of an elementary particle, i.e. when $r > r_0$, $W = c\sin\theta$. Therefore, the density distribution of the electric field intensity outside the sphere of an elementary particle is described by expression

$$\mathbf{E} = E\,\mathbf{r} = \frac{c\rho_0}{r}\frac{\partial V}{\partial \varphi}\mathbf{r}, \quad r > r_0.$$

Thus, the vector of the density distribution of the electric field intensity of a rolled photon of a double period is a wave vector of the form

$$\mathbf{E}_0(r,\theta,\varphi,t) = \frac{c\rho_0}{2r^2} V(\theta)\sin((\omega t - \varphi)/2)\,\mathbf{r},$$

and its positive and negative half-waves are the density distributions of the electric field intensities of the electron and positron (or proton and antiproton), respectively. Averaging the expressions obtained for each $r > r_0$ on surface of a sphere of radius r, we obtain expressions for the electric field intensities of elementary particles, depending only on the distance from the center of the particle:

$$\mathbf{E}_0(r) = 0, \quad \mathbf{E}_{\pm}(r) = \pm\frac{c\rho_0}{4\pi r^2}\int_0^{\pi}\int_0^{2\pi}\frac{V_{e,p}(\theta)}{2r^2}\sin(\xi/2) r^2 \sin\theta \, d\xi d\theta \; \mathbf{r} = \pm\frac{\rho_0 c V_q}{2\pi r^2}\mathbf{r} = \pm\frac{q}{r^2}\mathbf{r}.$$

Consequently, any rolled photon of a doubled period is electrically neutral with a constant average density of the ether inside it equal to ρ_0. The electric field of a negatively charged particle is directed toward its center, and the ether inside it is slightly compressed in comparison with its average density. The electric field of a positively charged particle is directed from its center, and the ether inside it is slightly rarefied compared to its average density. In this regard, it would be correct to assign a negative charge to proton, not to electron, because of the direction of the electric field, exactly negatively charged particles (small but massive protons) can attract and pull on themselves positively charged particles (large, but light electrons) with the subsequent formation of neutrons, hydrogen atoms, other atoms and matter structures. Otherwise, the antiprotons would attract positrons to themselves with the formation of antimatter structures, which is not observed in the Universe.

The resulting expressions are, in fact, the Coulomb's law. From them it follows that positive charges (here - electrons) repel with the force determined by Coulomb's law, and positive and negative charges (electrons and protons) attract with the same force. However, it does not follow from the expressions obtained that negative charges (here - protons) should be repelled. That is, it is quite probable that the Coulomb barrier in the nuclei of atoms simply does not exists. Its role can play a difference in the densities of the ether in nuclei and elementary particles.

Further, without violating the generally accepted agreements, but bearing in mind the above remark on the formation of matter structures, we assume that the electron and antiproton are negatively charged, and the proton and positron are positively charged.

3.1.5. Magnetic moments. To calculate the magnetic moments of elementary particles, we use the well-known formula in CGS system

$$\mathbf{p}_m = \frac{1}{2c}\int_{\Omega} \Delta[\mathbf{W}\cdot\mathbf{r}]\, d\Omega, \tag{3.8}$$

where electric charges with a distribution density Δ move within a volume Ω with a linear velocity $\mathbf{W}$.

As a rolled photon of double period has a density distribution of the total electric charge in the form of $\Delta_0 = 4\pi\delta_0(r,\theta,\xi)$, then density distributions of the total electric charge in the balls of positron and electron (or proton and antiproton) have a kind

$$\Delta_p = \frac{\rho_0\,\omega_p}{2r^2}V_p(\theta)\sin(\xi_p/2), \quad 0 \le \xi_p < 2\pi; \quad \Delta_e = \frac{\rho_0\omega_e}{2r^2}V_e(\theta)\sin(\xi_e/2), \quad -2\pi \le \xi_e < 0.$$

Substituting the obtained expressions for the densities distributions of the total electric charges of elementary particles (proton and electron) into formula (3.8) and taking into account that the motion of charges occurs around the vertical axis, so that $|\mathbf{r}| = r\sin\theta$, vectors $\mathbf{W}=\omega r\sin\theta\boldsymbol{\varphi}$ and $\mathbf{r}$ are orthogonal, we find that magnetic moment of a rolled photon of double period is zero and magnetic moments of proton and electron are

$$\begin{gathered} p_{mp,e} = \pm\frac{1}{2c}\int_0^{\pi}\int_0^{2\pi}\int_0^{r_{p,e}} \frac{\rho_0\omega_{p,e}}{2r^2}V_{p,e}(\theta)\sin(\xi/2)\omega_{p,e} r\sin\theta\, r\sin\theta\, r^2\sin\theta\; dr d\xi\, d\theta = \\ \pm\frac{\rho_0\omega_{p,e}^2\, r_{p,e}^3}{3c}V_{me} = \pm\frac{\rho_0 c\, r_{p,e}}{3}V_{mp,e}, \quad V_{mp,e} = \int_0^{\pi} V_{p,e}(\theta)\sin^3\theta\, d\theta. \end{gathered} \tag{3.9}$$

Let us express the magnetic moments of electron and proton through a Bohr magneton μ_B and a nuclear magneton μ_N. Since for any elementary particle $mcr_0 = mc^2/\omega = \hbar\omega/\omega = \hbar$ (see below), then the Bohr magneton and the nuclear magneton can be written in CGS system in the form

$$\mu_B = q\hbar/(2m_e c) = qr_e/2; \qquad \mu_N = q\hbar/(2m_p c) = qr_p/2. \tag{3.10}$$

Consequently, since $q = \rho_0 c V_q/(2\pi)$, then the expressions for the magnetic moments of electron and proton (3.9) can be written in terms of the Bohr magneton and the nuclear magneton as follows

$$p_{me} = -\frac{4\pi V_{me}}{3V_q}\frac{q\,r_e}{2} = \beta_e\mu_B, \qquad p_{mp} = \frac{4\pi V_{mp}}{3V_q}\frac{qr_p}{2} = \beta_p\mu_N, \tag{3.11}$$

$$V_{me,p} = V_0\int_0^{\pi}(a+\sin\theta \pm b\sin 2\theta + c_{e,p}\sin 3\theta)\sin^3\theta\, d\theta = V_0(\frac{4}{3}a + \frac{3\pi}{8} - \frac{\pi}{8}c_{e,p}) = \frac{\pi}{8}(\frac{32a}{3\pi} + 3 - c_{e,p})V_0.$$

Substituting the expressions for V_q and $V_{me,p}$ in (3.11) we obtain

$$\beta_e = -\pi(\frac{32a}{9\pi} + 1 - c_e/3)/(\frac{4a}{\pi}+1); \qquad \beta_p = \pi(\frac{32a}{9\pi} + 1 - c_p/3)/(\frac{4a}{\pi}+1). \tag{3.12}$$

We note that the magnetic moment of an electron does not add up from two halves of the orbital and spin magnetic moments. For an electron, like a proton, the magnetic moment is determined solely by the motions of the perturbation waves of the ether density inside the particle ball around its axis.

3.1.6. Internal energy and mass of particles. By the internal energy of any elementary particle we mean the total work done by the internal force fields of the particle over all charges distributed inside the volume of the particle. Since $\omega dt = d\varphi$, then the work dA done by the forces $\mathbf{F}$ of the internal field in time dt for moving with the linear velocity $\mathbf{W}$ of charges distributed with density Λ in the element of area $r\sin\theta\, d\theta dr$ is equal to the work on the displacement of these charges in the angle $d\varphi / \omega$ or in the volume $r^2 \sin\theta\, dr\, d\varphi d\theta / \omega$. Consequently,

$$dA = \Lambda(\mathbf{F}\cdot\mathbf{W}) r^2 \sin\theta\, dr\, d\varphi d\theta / \omega \tag{3.13}$$

Under the forces $\mathbf{F}$ of the internal field, the entire power term of the third equation of system (3.1) should be understood, and the density of all charges is the divergence of this power term. That is, $\mathbf{F} = F\boldsymbol{\varphi}$, where for a rolled photon

$$F = -\frac{\partial(\rho W)}{\partial t} \approx -\rho_0 2\omega r \sin\theta \frac{\partial g}{\partial t} = -\rho_0 \omega \sin\theta \frac{V(\theta)}{r} \varphi \sin(\omega t - \varphi/2),$$

$$\Lambda = div\, \mathbf{F} = \frac{1}{r\sin\theta} \frac{\partial F}{\partial\varphi} = -\rho_0 \omega \frac{V(\theta)}{r^2} \frac{\partial \varphi \sin(\omega t - \varphi/2)}{\partial\varphi}.$$

The work of internal forces over the charges of a rolled photon at any instant of time can be found by integrating (3.13) over the volume of photon, taking into account the collinearity of vectors $\mathbf{F}$ and $\mathbf{W}$:

$$A_{ph}(t) = \int_0^{\pi}\int_0^{2\pi}\int_0^{r_{ph}} \Lambda F\,(2\omega)\, r\sin\theta\; r^2 \sin\theta\; dr d\varphi\, d\theta /(2\omega) = \frac{1}{2}\int_0^{\pi}\int_0^{2\pi}\int_0^{r_{ph}} \rho_0^2 \omega^2 V^2(\theta) \frac{\partial}{\partial\varphi}(\varphi \sin(\omega t$$
$$-\varphi/2))^2 \sin^3\theta\, dr\, d\varphi\, d\theta = 2\rho_0^2\omega^2\pi^2 r_{ph} \sin^2(\omega t)\int_0^{\pi} V^2(\theta)\sin^3\theta\, d\theta.$$

Averaging the expression obtained for the period $2\pi/\omega$ and taking into account that $(2\omega) r_{ph} = c$, we obtain the value of the internal energy of the rolled photon in the form

$$\varepsilon_{ph} = \pi^2\rho_0^2 c V_\varepsilon (2\omega)/4 = \hbar(2\omega), \quad V_\varepsilon = \int_0^{\pi} V^2(\theta)\sin^3\theta d\theta, \quad \hbar = \pi^2\rho_0^2 c V_\varepsilon /4. \tag{3.14}$$

For a rolled photon of a doubled period, we obtain

$$F \approx -\rho_0\omega \sin\theta \frac{V(\theta)}{2r} \varphi \sin((\omega t - \varphi)/2), \quad \Lambda = -\rho_0\omega \frac{V(\theta)}{2r^2} \frac{\partial\varphi \sin((\omega t - \varphi)/2)}{\partial\varphi}.$$

The complete work of internal forces over the charges of a rolled photon of a doubled period at any instant of time is found in the form of a doubled integral (3.13) over the volume of the particle:

$$A_0(t) = 2\int_0^{\pi}\int_0^{2\pi}\int_0^{r_0} \Lambda F\;\omega r \sin\theta\; r^2 \sin\theta\; dr d\varphi\, d\theta/\omega = \frac{1}{4}\int_0^{\pi}\int_0^{2\pi}\int_0^{r_0} \rho_0^2\omega^2 V^2(\theta) \frac{\partial}{\partial\varphi}(\varphi\sin((\omega t$$
$$-\varphi)/2))^2 \sin^3\theta\, dr\, d\varphi\, d\theta = \rho_0^2\omega^2\pi^2 r_0 \sin^2(\omega t/2)\int_0^{\pi} V^2(\theta)\sin^3\theta\, d\theta.$$

Averaging the expression obtained over the period $2\pi/\omega$ and taking into account that $\omega r_0 = c$, we find that the value of the internal energy of a rolled photon of doubled period is equal to the value of the internal energy of the rolled photon

$$\varepsilon_0 = \pi^2 \rho_0^2 c V_\varepsilon \omega / 2 = 2\hbar\omega = \hbar(2\omega) = \varepsilon_{ph}.$$

For electron, proton, positron and antiproton, we obtain energy values equal to half of the energy values of the photons that produced them

$$A_{e,p}(t) = \int_0^{\pi}\int_0^{2\pi}\int_0^{r_{e,p}} \Lambda_{e,p} F_{e,p}\ \omega_{e,p}\ r\sin\theta\ r^2\sin\theta\ dr\,d\varphi\,d\theta / \omega_{e,p} = \frac{1}{8}\int_0^{\pi}\int_0^{2\pi}\int_0^{r_{e,p}} \rho_0^2\omega_{e,p}^2 V_{e,p}^2(\theta)\frac{\partial}{\partial\varphi}(\varphi\sin((\omega_{e,p}t$$

$$-\varphi)/2))^2\sin^3\theta\,dr\,d\varphi\,d\theta = \frac{1}{2}\rho_0^2\omega_{e,p}^2\pi^2 r_{e,p}\sin^2(\omega_{e,p}\,t/2)\int_0^{\pi} V_{e,p}^2(\theta)\sin^3\theta\,d\theta$$

Averaging the obtained expressions, respectively, for periods $2\pi/\omega_{e,p}$ and taking into account that $\omega_{e,p}\,r_{e,p} = c$, we obtain the values of the internal energy of electron and proton (positron and antiproton) in the form:

$$\varepsilon_e = \pi^2\rho_0^2 c V_{\varepsilon e}\omega_e/4, \qquad \varepsilon_p = \pi^2\rho_0^2 c V_{\varepsilon p}\omega_p/4, \qquad V_{\varepsilon e,p} = \int_0^{\pi} V_{e,p}^2(\theta)\sin^3\theta\,d\theta, \tag{3.15}$$

where the values $V_{\varepsilon e}$ and $V_{\varepsilon p}$ for the functions $V_e(\theta)$ and $V_p(\theta)$ of electron and proton given by formula (3.6) are:

$$V_{\varepsilon e,p} = \int_0^{\pi} V_0^2(a+\sin\theta \pm b\sin 2\theta + c_{e,p}\sin 3\theta)^2\sin^3\theta\,d\theta = V_0^2\left(\frac{4a^2}{3}+\frac{3a\pi}{4}+\frac{16}{15}+\frac{64}{105}b^2-\left(\frac{32}{35}+\frac{a\pi}{4}\right)c_{e,p}+\frac{208}{315}c_{e,p}{}^2\right).$$

From the existence of the Planck constant such that $\varepsilon_{ph} = \hbar(2\omega)$, $\varepsilon_e = \hbar\omega_e$, $\varepsilon_p = \hbar\omega_p$ in (3.14) and (3.15), it follows that $V_{\varepsilon e} = V_{\varepsilon p} = V_\varepsilon = V_0^2 d = const$, where d is a dimensionless constant. This makes it possible to correctly determine the Planck's constant through the parameters of the world ether

$$\hbar = \pi^2\rho_0^2 c V_\varepsilon/4 = \pi^2\rho_0^2 c V_0^2 d/4. \tag{3.16}$$

In this case, the values of the constants c_e, c_p must be the roots of the quadratic equation

$$\frac{4a^2}{3}+\frac{3a\pi}{4}+\frac{16}{15}+\frac{64}{105}b^2-\left(\frac{32}{35}+\frac{a\pi}{4}\right)c+\frac{208}{315}c^2-d=0 \quad\Rightarrow\quad c_e+c_p=\frac{315}{208}\left(\frac{32}{35}+\frac{a\pi}{4}\right) \tag{3.17}$$

Another fundamental physical constant of the microworld, along with the Planck constant, is the dimensionless fine structure constant $\alpha = q^2/\hbar c$. Substituting in the last formula the values of the universal charge and the Planck constant, determined above through the ether parameters, we obtain

$$\alpha = \frac{q^2}{\hbar c} = \frac{\rho_0^2 c^2 V_0^2(4a/\pi+1)^2}{16\pi^2\rho_0^2 c V_0^2 d\,c/4} = \frac{(4a/\pi+1)^2}{4\pi^2 d}. \tag{3.18}$$

As can be seen from (3.15), the internal energies of elementary particles are proportional to the angular velocity of the waves of the ether density inside the particles, and the Planck constant is the proportionality coefficient. In addition, if we introduce the mass of an elementary particle by the formula $m = \pi^2\rho_0^2 V_\varepsilon\,\omega/4c = \hbar\omega/c^2$, then we immediately obtain

$$\varepsilon_e = \hbar\omega_e = m_e c^2, \quad \varepsilon_p = \hbar\omega_p = m_p c^2, \quad \varepsilon_{phe,p} = \hbar(2\omega_{e,p}) = 2m_{e,p}c^2. \tag{3.19}$$

It can be concluded that the presence of mass in any elementary particle is a consequence of a change (compression or rarefaction) in the density of the perturbed ether inside the particle with respect to its density ρ_0 in the unperturbed state, and not as a result of the encounter of the particle with a certain mythical Higgs boson. Therefore, a rolled photon has energy, but has no mass. It also has no charge and magnetic moment. It also follows from formula (3.19) that the perimeter of the equator of the sphere of an elementary particle $(2\pi r_{e,p})$ is equal to its Compton wavelength $(2\pi\hbar/m_{e,p}c)$, and the radius of the ball of an elementary particle coincides with its Compton radius. That is, the radius of the electron ball is approximately 1836 times larger than the radius of the proton ball. Formulas (3.19) also explain the well-known experimental fact that the birth of a pair of elementary particles requires a photon energy that is not less than the doubled energy of each of the produced particles. There is also a reasonable explanation for the process of annihilation of a pair of elementary particles (for example, electron-positron), when they are combined a massless rolled photon of double period is generated and has a doubled energy and then generates two helical waves of two photons with equal energies and frequencies, moving in ether of constant density ρ_0 in opposite directions and with opposite spins.

3.1.7. The quadrupole momen tof proton. The experimental value of quadrupole moment of proton is equal to zero. We calculate its theoretical value, starting from the above proton ether model:

$$Q_p = \frac{1}{q}\int_0^{\pi}\int_0^{2\pi}\int_0^{r_p}(3r^2\cos^2\theta - r^2)\frac{\rho_0\omega V_p(\theta)}{8\pi r^2}\sin(\xi/2) r^2 \sin\theta\, dr\, d\xi\, d\theta = \frac{\rho_0\omega}{2\pi q}\int_0^{r_p} r^2\Big[\int_0^{\pi} 3\cos^2\theta V_p(\theta)\sin(\theta)d\theta - \int_0^{\pi} V_p(\theta)\sin(\theta)d\theta\Big]dr;$$

$$\int_0^{\pi} V_p(\theta)\sin(\theta)d\theta = V_q = V_0(2a+\pi/2), \qquad \int_0^{\pi} 3\cos^2\theta V_p(\theta)\sin\theta\, d\theta = V_0(2a + 3\pi/8 + 3c_p\pi/8),$$

Then equality $Q_p = 0$ makes it possible to determine the constant $c_p = 1/3$. The remaining constants in formulas (3.6) will be defined below in section 3.3.

3.2.*Ethereal model of neutron.*
There are two natural combinations of the interaction of perturbation waves of the ether density inside proton and electron: a combination with oppositely directed spins and a combination with unidirectional spins. As was shown earlier by the author in [8], the simplest combination of the interaction (imposition) of waves of electron and proton with oppositely directed spins is a hydrogen atom having a radius of its ground state considerably exceeding the radius of the electron. Let us now show that another simple combination of the interaction (imposition) of the waves of electron and proton with unidirectional spins is a neutron having a radius of its ground state slightly larger than the proton radius.

3.2.1. The structure of neutron. If an electron is superimposed on a proton under the influence of the electric field of a proton so that their centers coincide and they have unidirectional spins, then the angular velocities of the propagation of perturbation waves of the ether density inside the electron and the proton should increase, and their radii should decrease. Then $\tilde{\omega}_p > \omega_p$ is the angular velocity of propagation of perturbations of the ether density inside a compressed proton, which is a positively charged sphere with a radius $\tilde{r}_p < r_p$, and $\tilde{\omega}_e = \omega_n >> \omega_e$ is the angular velocity of propagation of perturbations of the ether density inside the compressed electron, which is a negatively charged sphere with a radius $\tilde{r}_e = r_n << r_e$. Inside the ball of a compressed proton, the ether is slightly compressed, and the ether in the compressed electron ball is slightly sparse, and $\omega_n r_n = \tilde{\omega}_p \tilde{r}_p = c$. Thus, in the neutron there is a central part (core) of radius $\tilde{r}_p$, which is a superposition of waves of positive and negative charges, and a peripheral part (fur coat) of radius $\tilde{r}_e = r_n$, also charged as an electron (we assume that it is negative). And since the degree of compression of the ether is inversely proportional to the frequency of the wave, then the compression of the ether inside the compressed proton is less than the rarefaction of the ether inside the compressed electron. Consequently, the ether inside the core of neutron is also sparse like the ether inside its fur coat. This is the meaning and purpose of neutrons in the atom - to remove the excess compression of the ether, caused by protons.

Since the energy of the proton is expended on the compression of the electron, the frequency of the perturbation wave of the ether density in the electron when it is compressed by the proton should be in a resonant relationship with the frequency of the perturbation wave of the ether density in the proton. That is, to start the process of electron compression by a proton, the electron must first be compressed by a factor of δ to the radius $\bar{r}_e$ corresponding to the resonant frequency $\overline{\omega}_e = c/\bar{r}_e = \omega_p / l$ of the proton, by means of some external energy source, and after that its radius should decrease a whole number of times $m = \omega_n / \overline{\omega}_e = \bar{r}_e / r_n$ in such a way that its initial radius also decreased a whole number of times $n = \delta m$. Such an external source of energy that provides for the preliminary compression of an electron is the electron antineutrino, that is, the perturbation of the ether density, which has a charge density wave in the form

$$\delta_-(r,\theta,\xi) = \frac{\rho_0 \omega_e}{8\pi r^2} V_0 \tilde{b} \sin(2\theta) \sin \xi_e / 2, \qquad -2\pi \le \xi_e = \omega_e - \varphi < 0. \tag{3.20}$$

A particle having a half-wave of the charge distribution density of the form (3.20) has energy, but does not have a charge, a magnetic moment, and a mass, since the corresponding integrals of the charge, the magnetic moment and the change in the average density of the ether over the particle ball are zero. The particle, which has an additional negative half-wave of the charge distribution density, is neutrino.

Since the antineutrino energy is interacting with an electron to increase the electron frequency up to $\overline{\omega}_e = \delta\omega_e$, then energy of electron, previously compressed to a resonance frequency with proton, is

$$\bar{\varepsilon}_e = \pi^2 \rho_0^2 c \omega_e (V_{\varepsilon e} + \tilde{V}_\varepsilon)/4 = \pi^2 \rho_0^2 c\, \overline{\omega}_e V_{\varepsilon e}/4 = \delta\varepsilon_e, \quad \tilde{V}_e = V_0^2 (64/105) \tilde{b}^2 .$$

After establishing the resonance frequencies of electron and proton, the formation of neutron begins in the process of electron and proton compression. It is natural to assume that the θ angle-dependent components of the radial oscillating perturbations of the ether density in both parts of the neutron are identical and equal to the average value (half-sum) of these components inside electron and proton, i.e.

$$V_n(\theta) = V_0(a + \sin\theta + (c_e/2 + c_p/2)\sin 3\theta).$$

This assumption means that the proton energy is consumed by the compression of the electron until the θ angle-dependent components coincide. In this case, the frequencies of the perturbation waves of the ether density in both parts of the neutron must be in the resonance ratio, i.e. their ratio should be a good rational, and preferably an integer number $k = \tilde{\omega}_p / \omega_n = r_n / \tilde{r}_p$. Parameters l, m, n, k will be defined below in the section 3.3.

3.2.2. The charge and magnetic moment of neutron. The charge of neutron as the sum of the charges of compressed proton and electron is obviously zero, since

$$q_n = \int_0^{\pi}\int_0^{2\pi}\int_0^{\tilde{r}_p} \frac{\rho_0\tilde{\omega}_p}{8\pi r^2} V_n(\theta) \sin(\xi_p/2) r^2 \sin\theta \, dr d\xi_p d\theta - \int_0^{\pi}\int_0^{2\pi}\int_0^{r_n} \frac{\rho_0\omega_n}{8\pi r^2} V_n(\theta)\sin(\xi_n/2) r^2 \sin\theta \, dr d\xi_n d\theta = \frac{\rho_0 c V_n}{2\pi} - \frac{\rho_0 c V_n}{2\pi} = 0.$$

The magnetic moment of the neutron is calculated as the sum of the magnetic moments of the compressed proton and electron:

$$p_{mn} = \frac{1}{2c}\int_0^{\pi}\int_0^{2\pi}\int_0^{\tilde{r}_p} \frac{\rho_0\tilde{\omega}_p}{2r^2} V_n(\theta)\sin(\xi_p/2)\tilde{\omega}_p r\sin\theta r\sin\theta r^2 \sin\theta \, dr d\xi_p d\theta - \frac{1}{2c}\int_0^{\pi}\int_0^{2\pi}\int_0^{r_n} \frac{\rho_0\omega_n}{2r^2} V_n(\theta)\sin(\xi_n/2)\omega_n r\sin\theta r\sin\theta r^2\sin\theta \, dr d\xi_n d\theta$$

$$= \frac{\rho_0 \tilde{\omega}_p^2 \tilde{r}_p^3}{3c} V_{mn} - \frac{\rho_0 \omega_n^2 r_n^3}{3c} V_{mn} = \frac{\rho_0 c}{3} V_{mn} (\tilde{r}_p - r_n), \qquad V_{mn} = \int_0^{\pi} V_n(\theta) \sin^3\theta \, d\theta.$$

We write the magnetic moment of the neutron in terms of nuclear magneton

$$p_{mn}=-\frac{\rho_0 c r_n V_{mn}}{3}(1-\frac{1}{k})=-\frac{2\rho_0 c r_n}{3}(1-\frac{1}{k})\frac{\pi}{8}(\frac{32a}{3\pi}+3-\frac{(c_e+c_p)}{2})V_0=-\frac{q r_p}{2}\left[\pi\frac{r_n}{r_p}(1-\frac{1}{k})(\frac{32a}{9\pi}+1-\frac{(c_e+c_p)}{6})\right]/(\frac{4a}{\pi}+1).$$

And, since $r_n / r_p = \omega_p / \omega_n = (\bar{r}_e / r_p)/(\bar{r}_e / r_n) = l/m$, then the value of the magnetic moment of neutron in units of a nuclear magneton is:

$$\beta_n = -\left[\frac{\pi l}{m}(1-\frac{1}{k})(\frac{32a}{9\pi}+1-\frac{(c_e+c_p)}{6})\right]/(\frac{4a}{\pi}+1). \quad (3.21)$$

3.2.3. Energy and mass of neutron. We calculate the neutron energy as the sum of the energies of compressed proton and compressed electron. First, we calculate the work done by the fields of the compressed proton and electron over the charges moving in them:

$$A_e(t)=\frac{1}{8}\int_0^{\pi}\int_0^{2\pi}\int_0^{r_n}\rho_0^2\omega_n^2 V_n^2(\theta)\frac{\partial}{\partial\varphi}(\varphi\sin((\omega_n t-\varphi)/2))^2\sin^3\theta\, dr\, d\varphi\, d\theta = \frac{1}{2}\pi^2\rho_0^2\omega_n^2 r_n \sin^2(\omega_n t/2)V_{\varepsilon n},$$

$$A_p(t)=\frac{1}{8}\int_0^{\pi}\int_0^{2\pi}\int_0^{\tilde{r}_p}\rho_0^2\tilde{\omega}_p^2 V_n^2(\theta)\frac{\partial}{\partial\varphi}(\varphi\sin((\tilde{\omega}_p t-\varphi)/2))^2\sin^3\theta\, dr\, d\varphi\, d\theta=\frac{1}{2}\pi^2\rho_0^2\tilde{\omega}_p^2\tilde{r}_p V_{\varepsilon n}\sin^2(\tilde{\omega}_p t/2),\quad V_{\varepsilon n}=\int_0^{\pi}V_n^2(\theta)\sin^3\theta\, d\theta.$$

Averaging the expressions obtained over time for a period, we find the energy ε_n and mass m_n of the neutron in the form

$$\varepsilon_n = \pi^2\rho_0^2 c(\tilde{\omega}_p+\omega_n)V_{\varepsilon n}/4=\pi^2\rho_0^2 c\,(k+1)V_{\varepsilon n}\omega_n/4,\quad m_n=\varepsilon_n/c^2,$$

where

$$V_{\varepsilon n}=V_0^2\left[\frac{4a^2}{3}+\frac{3a\pi}{4}+\frac{16}{15}-(\frac{32}{35}+\frac{a\pi}{4})\frac{(c_e+c_p)}{2}+\frac{208}{315}(\frac{c_e+c_p}{2})^2\right]=V_0^2 d_n. \quad (3.22)$$

3.3 .Comparison with experimental data

Since $c_p = 1/3$, then from the formula (3.12) we find the value of the magnetic moment of proton: $\beta_p = 8\pi/9 = 2.79253$, which differs from the experimentally determined value $\beta_p \approx 2.7928$ by less than 0.01%. The value of c_e is found from (3.17). Then for $a = 1/7$ we find the value of the magnetic moment of electron: $\beta_e = -2.0058$, which differs from the experimentally determined value $\beta_e = -2.0023$ ([9], p.126) by less than 0.17%

Further, since the energy (mass) of neutron is equal to the sum of energies (masses) of proton and electron which is compressed in δ times, then

$$\pi^2\rho_0^2 c(k+1)V_{\varepsilon n}\omega_n/4=\pi^2\rho_0^2 c(k+1)V_{\varepsilon n}m\bar{\omega}_e/4=\varepsilon_p+\bar{\varepsilon}_e=\pi^2\rho_0^2 c(l+1)V_\varepsilon\bar{\omega}_e/4 \;\Rightarrow\; (k+1)m d_n=(l+1)d, \quad (3.23)$$

We now define the parameters: $k=4$, $m=682$, $l=726$, $m\delta=n=1725$, $l/m=726/682=33/31$. Then from the formulas (3.18), (3.21)-(3.23) we find

$\delta=n/m=1725/682\approx 2.529326;\quad d_n=1.0315501;\quad d=(k+1)m/(l+1)d_n=4.8384949;$

$m_p=l\delta m_e\approx 1836.29m_e\,(\varepsilon_p\approx 1836.29\varepsilon_e)\approx 938.342\text{MeV};\ m_n=(l+1)\delta m_e\approx 1838.82m_e\approx 939.635\text{MeV};$

$m_n-m_p=\delta m_e\approx 2.529326m_e;\ \beta_n=-1.7993895\,r_n/r_p=-1.9154;\ \alpha=(4a/\pi+1)^2/(4\pi^2 d)=0.0073128$

Table 1. Comparison the values of energies and magnetic moments of basic structural units of matter

Value		Experiment	Calculation by ether	Inaccuracy
Magnetic moments (in Bohr and nuclear magnetons)	p(^{1}H)	2.7927	2.792526	0.01%
	e	-2.0023	-2.0058	0.17%
	n	-1.9131	-1.9154	0.13%
Internal energy (MeV)	p(^{1}H)	938.272046	938.342	0.0075%
	e	0.5109989461	0.5109989461	0%
	n	939. 565379	939.635	0.0075%
Fine structure constant	(α)	0.00729735	0.0073128	0.2%

4. Conclusion

In this paper, based on the ether equations derived from common sense and the laws of classical mechanics, a generalized nonlinear system of Maxwell-Lorentz equations invariant under Galileo transformations is derived, ethereal mathematical models of electron, proton and neutron are constructed, reasonable definitions are given and formulas are derived for their charges, energies, masses and magnetic moments, the numerical values of which almost exactly coincide with the experimental so-called "anomalous" values. Representations for the Planck constant and the fine structure constant through the ether parameters and the mechanism of particle and antiparticle creation from a photon of double energy, and the particle annihilation mechanism are obtained.

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