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Theory of Elementary Particles Based on Newtonian Mechanics

Nikolai A. Magnitskii
LLC "New Inflow", Moscow, Russia

1. Introduction

The basis of modern conception of the world consists of two phenomenological theories (theory of quantum mechanics and theory of relativity), both largely inconsistent, but, in a number of cases, suitable for evaluation of experimental data. Both of these theories have one thing in common: their authors are convicted in limitations of laws and equations of classical mechanics, in absolute validity of Maxwell equations and in essential distinction of laws and mechanisms of the device of macrocosm and microcosm. Nevertheless, such assurance, being dominant in physics in the last hundred years, hasn't resulted in creation of unifying fundamental physical theory, nor in essential understanding of principal physical conceptions, such as: electric, magnetic and gravitational fields, matter and antimatter, velocity of light, electron, photon and other elementary particles, internal energy, mass, charge, spin, quantum properties, Planck constant, fine structure constant and many others. All laws and the equations of modern physics are attempts to approximate description of the results of natural experiments, rather than strict theoretical (mathematical) findings from the general and uniform laws and mechanisms of the device of the world surrounding us. Moreover, some conclusions from modern physics equations contradict experimental data such as infinite energy or mass of point charge.

In papers (Magnitskii, 2010a, 2011a) bases of the unifying fundamental physical theory which a single postulate is the postulate on existence of physical vacuum (ether) are briefly stated. It is shown, that all basic equations of classical electrodynamics, quantum mechanics and gravitation theory can be derived from two nonlinear equations, which define dynamics of physical vacuum in three-dimensional Euclidean space and, in turn, are derived from equations of Newtonian mechanics. Furthermore, clear and sane definitions are given to all principal physical conceptions from above through the parameters of physical vacuum, namely its density and propagation velocity of various density's perturbations. Thereby, it is shown that a set of generally unrelated geometric, algebraic and stochastic linear theories of modern physics, which are fudged to agree with experimental data and operating with concepts of multidimensional spaces and space-time continuums, can be replaced with one nonlinear theory of physical vacuum in ordinary three-dimensional Euclidean space, based exclusively on laws of classical mechanics.

In the present paper research of system of equations of physical vacuum is continued with the purpose of studying and the description of processes of a birth of elementary particles and their properties. A system of equations of electrodynamics of the physical vacuum, generalizing classical system of Maxwell's equations and invariant under Galilean transformations is deduced. Definition of the photon is given and process of its curling and a birth from the curled photon of a pair of elementary particles possessing charge, mass and spin are described. The model of an elementary particle is constructed, definitions of its electric and gravitational fields are given and absence of a magnetic field is proved. Coulomb's law and Schrodinger's and Dirac's equations for electric field and also the law of universal gravitation for gravitational field are deduced. Definitions of electron, positron, proton, antiproton and neutron are given, and absence of graviton is proved. The elementary model of atom of hydrogen is constructed.

Postulate. All fields and material objects in the Universe are various perturbations of physical vacuum, which is dense compressible inviscid medium in three-dimensional Euclidean space with coordinates $\vec{r} = (x, y, z)^T$, having in every time station t density $\rho(\vec{r},t)$ and perturbation propagation velocity vector $\vec{u}(\vec{r},t) = (u_1(\vec{r},t), u_2(\vec{r},t), u_3(\vec{r},t))^T$ **.**

With such problem definition, it's natural to consider that no external forces apply any tension on elements of physical vacuum. Therefore, in compliance with Newtonian mechanics equations of physical vacuum dynamics in the neighborhood of homogeneous stationary state of its density ρ_0 should be as follows:

$$\frac{\partial \rho}{\partial t} + div(\rho \vec{u}) = 0, \ \frac{\partial(\rho \vec{u})}{\partial t} + (\vec{u} \cdot \nabla)(\rho \vec{u}) = 0, \tag{1}$$

where first equation is an equation of continuity, and second is the momentum equation. Let's notice, that the physical vacuum has no mass and in this connection dimension of its density does not coincide with dimension of substance (matter).

2. Electrodynamics of physical vacuum

Let's consider a case in which perturbation propagation velocity $\vec{u}$ has a certain direction in physical vacuum set by unit vector $\vec{n}$. Solutions of the system of equations (1) we shall search in the form of

$$\vec{u}(\xi,t) = v(\xi,t)\vec{n} + w(\xi,t)\vec{m}, \ \xi = (\vec{r} \cdot \vec{n}), \ (\vec{m} \cdot \vec{n}) = 0, \ \rho = \rho(\xi,t). \tag{2}$$

Note that the vector of perturbation propagation velocity in physical vacuum can have both transverse and longitudinal components in relation to the direction of propagation of perturbations. Substituting expression for the vector $\vec{u}$ in equations (1) and taking into account, that

$$(w\vec{m} \cdot \nabla)(\rho \vec{u}(\xi,t)) = 0, \ (v\vec{n} \cdot \nabla)(\rho \vec{u}(\xi,t)) = v\frac{\partial(\rho \vec{u})}{\partial \xi}, \ div(\rho w \vec{m}) = 0, \ div(\rho v \vec{n}) = \frac{\partial(\rho v)}{\partial \xi},$$

one can obtain a system of the equations for functions $\rho(\xi,t), v(\xi,t), w(\xi,t)$:

$$\frac{\partial \rho}{\partial t} + \frac{\partial(\rho v)}{\partial \xi} = 0, \ \frac{\partial(\rho v)}{\partial t}\vec{n} + v\frac{\partial(\rho v)}{\partial \xi}\vec{n} = 0, \ \frac{\partial(\rho w)}{\partial t}\vec{m} + v\frac{\partial(\rho w)}{\partial \xi}\vec{m} = 0, \tag{3}$$

which we call the *system of the equations of electrodynamics of physical vacuum*

2.1 Plane electromagnetic waves. Photon structure

In the particular case of transverse fluctuations of physical vacuum of constant density $(\rho(\xi,t)=\rho_0=const)$ and distribution of these fluctuations in a longitudinal direction with constant velocity $v(\xi,t)=c$ the system of equations (3) can be reduced to one equation in one complex variable $w(\xi,t)$:

$$\frac{\partial(\rho w)}{\partial t}\vec{m}+c\frac{\partial(\rho w)}{\partial \xi}\vec{m}=0. \tag{4}$$

Let's introduce into consideration vectors of electric $\vec{E}$ and magnetic $\vec{H}$ fields intensities by the formulas:

$$\vec{H}=c\,rot(\rho\vec{u}),\ \vec{E}=c(\vec{n}\cdot\nabla)(\rho\vec{u}). \tag{5}$$

In the general case of propagation of perturbations in compressible physical vacuum of variable density the vector of electric field intensity has both transverse and longitudinal components, and its divergence is not zero and can be interpreted as linear density of a charge (see item. 2.3). In the considered case of propagation of perturbations in physical vacuum of constant density with constant velocity only transverse component of a vector of electric field intensity is not zero, and its divergence is equal to zero. It is also clear that so defined vector of magnetic field intensity has only a transverse component, divergence of which also is equal to zero, and the vector $c\rho\vec{u}=\vec{A}$ is the vector of potential in classical electrodynamics.

Applying to the equation (4) consistently the operators $c\,rot$ and $c(\vec{n}\cdot\nabla)$ and taking into account, that in the considered case

$$rot\,\vec{H}=rot(c\,rot(\rho w\vec{m}))=-c\nabla^2(\rho w\vec{m})=-c\frac{\partial^2(\rho w)}{\partial\xi^2}\vec{m},\ \vec{E}=c(\vec{n}\cdot\nabla)(\rho w\vec{m})=c\frac{\partial(\rho w)}{\partial\xi}\vec{m},$$

we shall obtain the classical system of Maxwell's equations describing the propagation of electromagnetic waves in the so-called empty space (vacuum):

$$\begin{aligned}&\frac{\partial\vec{H}}{\partial t}+c\,rot\,\vec{E}=0,\quad div\,\vec{H}=0,\\&\frac{\partial\vec{E}}{\partial t}-c\,rot\,\vec{H}=0,\quad div\,\vec{E}=0.\end{aligned} \tag{6}$$

The system of equations (6) has a solution in the form

$$\vec{E}=\vec{E}_0\,e^{i(\omega t-k\xi)},\ \vec{H}=\vec{H}_0\,e^{i(\omega t-k\xi)},\quad \omega=kc. \tag{7}$$

It is considered to be, that the real parts of complex expressions (7) have physical sense. They determine an in-phase plane transverse electromagnetic wave, propagating with a speed of light c in any direction set by an unit vector $\vec{n}$. The unique characteristic of a classical plane electromagnetic wave is its frequency ω (or its wavelength $\lambda=2\pi c/\omega$). Note, that in-phase vectors of electric and magnetic fields intensities periodically vanish simultaneously that contradicts the law of conservation of energy and raises doubts about validity of classical interpretation of an electromagnetic wave in which a change of the electric field causes a change in the magnetic field and vice versa. In turn, the equation (4) has as its solution a spiral wave of constant amplitude w_0

$$w(\xi,t)\vec{m} = (w^* + w_0\, e^{i(\omega t - k\xi)})\vec{m}, \;\; \omega = kc, \tag{8}$$

propagating with velocity c in physical vacuum in a direction of a vector $\vec{n}$ with conservation of energy carried by the wave and having arbitrary constant shift w^* in a direction of a vector $\vec{m}$. In such formulation the speed of light c in empty space has a clear physical sense - it is the propagation velocity of perturbations of physical vacuum of constant density in the absence of matter (the birth process of elementary particles of matter and antimatter as a result of perturbations of physical vacuum is described in Sec. 3). And since in this case the vectors $\vec{E}$ and $\vec{H}$ of a classical plane electromagnetic wave are a directional derivative and a rotor of a vector $c\rho_0 w(\xi,t)\vec{m}$, it is possible to conclude, that the classical electromagnetic wave (7) is an artificial form and is completely determined by the spiral wave (8) of perturbations propagation in physical vacuum, and

$$\vec{E}_0 = -ikc\rho_0 w_0 \vec{m}, \;\; \vec{H}_0 = -ikc\rho_0 w_0 [\vec{m}\cdot\vec{n}]. \tag{9}$$

Suppose, for example, the transverse wave is propagated in physical vacuum in the direction of the axis y, so $w_0\vec{m} = (w_{0x}, 0, w_{0z})^T$. Then $\xi = y$ and

$$\vec{E} = ck\,\rho_0 (w_{0x}, 0, w_{0z})^T \sin(\omega\, t - ky) = (E_{0x}, 0, E_{0z})^T \sin(\omega\, t - ky) = \vec{E}_0 \sin(\omega\, t - ky),$$

$$\vec{H} = ck\rho_0 (w_{0z}, 0, -w_{0x})^T \sin(\omega\, t - ky) = (E_{0z}, 0, -E_{0x})^T \sin(\omega\, t - ky) = \vec{H}_0 \sin(\omega\, t - ky).$$

That is, in full accordance with classical electrodynamics, vectors $\vec{E}_0$ and $\vec{H}_0$ are perpendicular to the axis y and perpendicular to each other, and their moduli are equal (Fig. 1a). In Fig. 1b for comparison the propagation of the spiral wave (8) in the physical vacuum of constant density is represented.

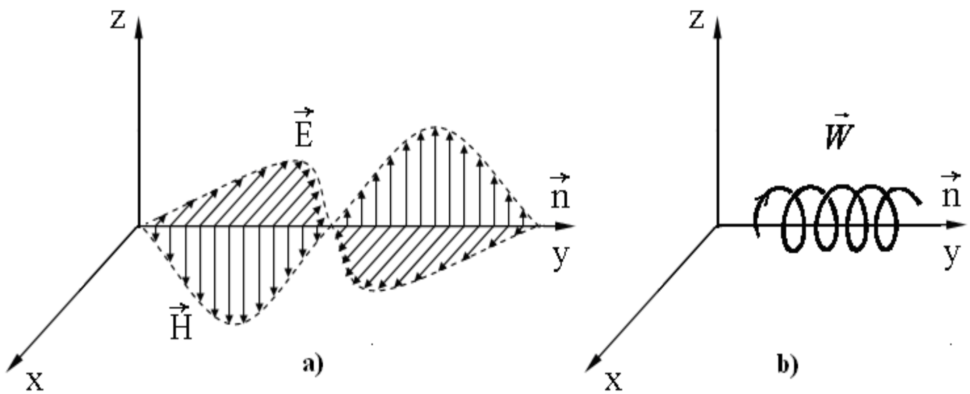

Fig. 1. Propagation of a classical plane electromagnetic wave (a) and a spiral wave of physical vacuum (b).

Now we can compare the spiral wave in the physical vacuum, obtained as the solution of the equation (4), and the classical electromagnetic wave, obtained as the solution of system of Maxwell's equations (6). Both waves have an arbitrary frequencies and corresponding wavelengths, so the two solutions describe all plane transverse electromagnetic waves existing in nature. However, it is easy to see from the above analysis, that the vectors of classical electric and magnetic fields are artificial vectors, namely, the derivatives of the same true vector of the velocity perturbations propagation in the physical vacuum. Furthermore, a classical electromagnetic wave (Fig. 1a) does not allow to correctly define the concept of a quantum of electromagnetic waves (photon), because it except for wavelength λ needs also knowledge of the oscillation amplitude. The kind of a spiral wave of perturbations propagation in physical vacuum allows the unique determination of the photon - it's a part of the cylindrical volume of the physical vacuum under a spiral of a wavelength λ and radius $r_0 = c / \omega = \lambda / 2\pi$. Wave motion on a spiral inside the given volume occurs with a constant angular velocity ω , and linear velocity reaches its maximum value (the speed of light c) on the lateral surface of the cylinder. Exactly such photon colliding with an obstacle and being compressed is capable to generate elementary particles and antiparticles in the form of balls of radius r_0 (for more details about the birth of elementary particles, see Sec. 3). In addition, among the solutions of Maxwell's equations (6) in the form of classical electromagnetic waves, in principle, there are no solutions corresponding to the constant shift w^* of transverse wave of physical vacuum (8). This, as it will be shown below, is the main reason that Maxwell's equations are not invariant under Galilean transformations, and, moreover, they cannot be modified so that they would satisfy these transformations.

2.2 Galileo transformations of electrodynamics equations

Consider an inertial rest reference frame $O(x, y, z)$ and moving relative to it uniformly and rectilinearly with constant velocity $\vec{v}$ reference frame $O'(x', y', z')$. Without loss of generality, we assume that the respective axes are parallel to each other. Galilean transformations corresponding to common sense and centuries of experience are called transformations of coordinates and time in the transition from one inertial reference frame to another:

$$\vec{r}' = \vec{r} - \vec{v}t, \quad t' = t, \quad \vec{u}' = \vec{u} - \vec{v}.$$

Galilean transformation implies the same time in all frames of reference (absolute time). It is known also that all equations of classical mechanics are written the same in any inertial reference system, i.e. they are invariant under Galilean transformations. Let's show that any law, mathematical notation of which represents the full time derivative of any function $f(\vec{r}, t)$ of coordinates and time is invariant under the Galilean transformations. Indeed, taking into account, that $t' = t$ and $\nabla' = \nabla$ we shall obtain

$$\frac{df(\vec{r},t)}{dt} = \frac{\partial f(\vec{r},t)}{\partial t} + (\vec{u}\cdot\nabla)(f(\vec{r},t)) = \frac{\partial f'(\vec{r}',t')}{\partial t} + ((\vec{u}'+\vec{v})\cdot\nabla)(f'(\vec{r}',t')) = \frac{\partial f'(\vec{r}',t')}{\partial t'}\frac{\partial t'}{\partial t}$$
$$+\frac{\partial f'(\vec{r}',t')}{\partial \vec{r}'}\frac{\partial \vec{r}'}{\partial t} + ((\vec{u}'+\vec{v})\cdot\nabla)(f'(\vec{r}',t')) = \frac{\partial f'(\vec{r}',t')}{\partial t'} - (\vec{v}\cdot\nabla)(f'(\vec{r}',t')) +$$
$$((\vec{u}'+\vec{v})\cdot\nabla)(f'(\vec{r}',t')) = \frac{\partial f'(\vec{r}',t')}{\partial t'} + (\vec{u}'\cdot\nabla')(f'(\vec{r}',t')) = \frac{df'(\vec{r}',t')}{dt'}.$$

From this assertion follows immediately that the physical vacuum equations (1) are invariant under the Galilean transformations, since

$$\frac{\partial(\rho\vec{u})}{\partial t}+(\vec{u}\cdot\nabla)(\rho\vec{u})=\frac{d(\rho\vec{u})}{dt},\ \frac{\partial\rho}{\partial t}+div(\rho\vec{u})=\frac{d\rho}{dt}+\rho(\nabla\cdot\vec{u}).$$

Also the system of equations of electrodynamics of physical vacuum (3) is invariant under the Galilean transformation that follows from the system of equations (1).
Now consider in reference frames $O(x,y,z)$ a spiral wave of perturbations of physical vacuum of the form

$$\vec{u}(\xi,t)=c\vec{n}+w(\xi,t)\vec{m}=c\vec{n}+w_0e^{i(\omega t-k\xi)}\vec{m},\ \ \omega=kc,\ \xi=(\vec{r}\cdot\vec{n}),\ (\vec{m}\cdot\vec{n})=0. \tag{10}$$

As it shown above, to this solution of system of equations (1) with the function $w(\xi,t)$ satisfying the equation (4) there corresponds a classical electromagnetic wave, electric and magnetic fields intensities vectors of which are the directional derivative and the rotor of the vector $c\rho_0 w(\xi,t)\vec{m}$. In accordance with the Galilean transformations the considered solution has the form in the frame of reference $O'(x',y',z')$

$$\vec{u}'(\xi',t)=c\vec{n}-\vec{v}+w_0e^{i(\omega't-k\xi')}\vec{m},\ \xi'=(\vec{r}'\cdot\vec{n})=\xi-(\vec{v}\cdot\vec{n})t,$$
$$\omega'=\omega-k(\vec{v}\cdot\vec{n})=k(c-(\vec{v}\cdot\vec{n}))=kc'.$$

Expanding now the vector $\vec{v}$ in the basis $(\vec{n},\vec{m}):\vec{v}=(\vec{v}\cdot\vec{n})\vec{n}-w^*\vec{m}$, we obtain

$$\vec{u}'(\xi',t)=c'\vec{n}+w'\vec{m}=c'\vec{n}+(w^*+w_0e^{i(\omega't-k\xi')})\vec{m},\ \omega'=kc'. \tag{11}$$

Solution (11) is the solution of equations (1) and (3) in the reference frame $O'(x',y',z')$. However, to obtain such solution from system of Maxwell's equations (6) is fundamentally impossible, even in case of failure of the postulate of the constancy of the speed of light with a replacement in (6) c on c'. The reason is that the differentiation of the solution (11) eliminates a constant shift w^* of transverse component of velocity of perturbations propagation. Note also that the transition from the solution (10) to the solution (11) is accompanied by the Doppler effect, that is changing of the oscillation frequency $\omega'=\omega-k(\vec{v}\cdot\vec{n})$. When a radiation source located in a reference frame $O(x,y,z)$ moves in the direction of an observer which is in the reference frame $O'(x',y',z')$, the oscillation frequency increases $((\vec{v}\cdot\vec{n})<0)$, and at movement in an opposite direction - decreases $((\vec{v}\cdot\vec{n})>0)$.
From the above it follows that, in contrast to the equations of a spiral wave (3) which are invariant under Galilean transformations, Maxwell's equations (6) describe the propagation of plane electromagnetic waves in moving inertial reference frames only approximately for small $w^*<<c$. It is well known that the main cause of occurrence of the special theory of relativity in the early twentieth century were contradictions between electrodynamics, described by Maxwell's equations and classical mechanics, governed by the equations and Newton's laws. During the crisis of world science it was necessary to make a choice between two possibilities: a) either to admit that Maxwell's equations are not absolutely correct and are need to be changed so that they should satisfy the Galilean transformations; b) or to recognize that equations of classical mechanics are not quite correct and should be

considered only as an approximation to the true equations, satisfying the Lorentz transformations. Unfortunately, world science has chosen the second option, despite the reasoned objections of many outstanding scientists of the last century, among which the first is the name of Nikola Tesla (Tesla, 2003). The way chosen by world science has led to an absolutization of speed of light and Maxwell's equations and has led to full termination of researches in the field of search more general equations of electrodynamics satisfying the principle of Galilean relativity. The present research proves that the correct way to exit from the crisis of science in early twentieth century was not in updating the equations of classical mechanics with the use of relativistic additives but, on the contrary, in finding the equations generalizing Maxwell's equations and satisfying the Galilean transformations.

2.3 Longitudinal electromagnetic waves. Currents

Consider the general case of propagation of spiral waves (2) in physical vacuum of variable density. As shown in Sec. 2.1, these waves are solutions of the equations of electrodynamics of physical vacuum (3). Applying to the sum of the second and the third equations of system (3) consistently the operators $c\,rot$ and $c(\vec{n}\cdot\nabla)$ we obtain for the electric and magnetic fields intensities vectors defined by formulas (5), the system of equations

$$\begin{aligned} &\frac{\partial \vec{H}}{\partial t} + v\,rot\,\vec{E} + \frac{\partial v}{\partial \xi}\vec{H} = 0, \quad div\,\vec{H} = 0, \\ &\frac{\partial \vec{E}}{\partial t} - v\,rot\,\vec{H} + \frac{\partial v}{\partial \xi}\vec{E} + cv\frac{\partial^2(\rho v)}{\partial \xi^2}\vec{n} = 0, \quad div\,\vec{E} = c\frac{\partial^2(\rho v)}{\partial \xi^2}. \end{aligned} \qquad (12)$$

Note that in this case the electric field intensity vector $\vec{E}$ has a nonzero longitudinal component even at $v = c = const$. This component is determined by small periodic compression-tension of density of physical vacuum in a longitudinal direction of propagation of electromagnetic wave.

Let's introduce into consideration the linear charge density ρ_{ch} and current density $\vec{j}$ by the formulas

$$4\pi\rho_{ch} = div\,\vec{E} = div(c\frac{\partial(\rho v)}{\partial \xi}\vec{n}) = c\frac{\partial^2(\rho v)}{\partial \xi^2} = c\nabla^2(\rho v), \ \vec{j} = \rho_{ch} v\vec{n}.$$

Then from (12) we shall obtain the system of equations

$$\begin{aligned} &\frac{\partial \vec{H}}{\partial t} + v\,rot\,\vec{E} + \frac{\partial v}{\partial \xi}\vec{H} = 0, \quad div\,\vec{H} = 0, \\ &\frac{\partial \vec{E}}{\partial t} - v\,rot\,\vec{H} + \frac{\partial v}{\partial \xi}\vec{E} + 4\pi\vec{j} = 0, \quad div\,\vec{E} = 4\pi\rho_{ch}. \end{aligned} \qquad (13)$$

The system of equations (13) at $v = c = const$ is a classical system of Maxwell's equations in the presence of charges and currents. It follows from here that charges and currents can exist in physical vacuum even at the absence of substance (matter) in it. Thus, a current in the sense of classical system of Maxwell's equations (13) at $v = c = const$ is not the motion of charges, but it is the second derivative (Laplacian) from propagating with the speed of light longitudinal wave of periodic compression - stretching of density of physical vacuum.

Note that the substance (matter) is formed by elementary particles with the space charge and being waves of compression - stretching of density of physical vacuum, propagating along the parallels of spheres of radius $r \le r_0$ (see Sec. 3). Therefore, in substance the propagation of longitudinal waves (currents) also is possible.

As it is already mentioned above, the classical system of Maxwell's equations describing propagation of electromagnetic waves in presence of charges and currents can be obtained from (13) at $v = c$. However, in general, the velocity of propagation of longitudinal waves in physical vacuum is not constant, but undergoes small periodic oscillations around the constant c . Therefore, the generalized system of equations of electrodynamics (13) has a much wider spectrum of solutions in comparison with the classical system of Maxwell's equations. In addition, the first two equations of system (13) at $v = c = const$ representing the Faraday's law of induction

$$\frac{\partial \vec{H}}{\partial t} + c\,rot\ \vec{E} = 0, \quad div\ \vec{H} = 0,$$

can be obtained by applying the operator $c\,rot$ directly to the linearized second equation of the physical vacuum equations (1). Therefore, these equations can be considered approximately always satisfied, but it is impossible to say about the second pair of equations of system (13), which are not always executed. Moreover, as follows from the analysis of item 2.2, the system of equations (13) and, consequently, the system of Maxwell's equations are not absolutely correct for the reason that they do not satisfy the Galilean transformations and describe the propagation of electromagnetic waves in moving inertial reference frames only approximately for small velocities of movement of such systems relatively to the speed of light. In all cases of the description of processes of propagation of both transverse and longitudinal waves in physical vacuum the system of equations (3) is correct. For the description of other more complex perturbations of physical vacuum connected, for example, with a birth of elementary particles and their electric and gravitational fields, it is necessary to use directly the equations of physical vacuum (1) (see Sec. 3).

3. Elementary particles of a matter

We show in this section that processes of a birth of elementary particles of matter and antimatter from the physical vacuum (ether), as well as all basic quantum-mechanical properties of elementary particles can be obtained from the system of equations (1) written in spherical system of coordinates:

$$\begin{aligned}
&\frac{\partial \rho}{\partial t} + \frac{1}{r^2}\frac{\partial (r^2 \rho V)}{\partial r} + \frac{1}{r\sin\theta}\frac{\partial(\rho\Omega\sin\theta)}{\partial\theta} + \frac{1}{r\sin\theta}\frac{\partial(\rho W)}{\partial\varphi} = 0,\\
&\frac{\partial(\rho V)}{\partial t} + V\frac{\partial(\rho V)}{\partial r} + \frac{\Omega}{r}\frac{\partial(\rho V)}{\partial\theta} + \frac{W}{r\sin\theta}\frac{\partial(\rho V)}{\partial\varphi} = 0,\ (\vec{r})\\
&\frac{\partial(\rho\Omega)}{\partial t} + V\frac{\partial(\rho\Omega)}{\partial r} + \frac{\Omega}{r}\frac{\partial(\rho\Omega)}{\partial\theta} + \frac{W}{r\sin\theta}\frac{\partial(\rho\Omega)}{\partial\varphi} = 0,\ (\vec{\theta})\\
&\frac{\partial(\rho W)}{\partial t} + V\frac{\partial(\rho W)}{\partial r} + \frac{\Omega}{r}\frac{\partial(\rho W)}{\partial\theta} + \frac{W}{r\sin\theta}\frac{\partial(\rho W)}{\partial\varphi} = 0,\ (\vec{\varphi})
\end{aligned} \tag{14}$$

where $\vec{u}=(V_r,\ V_\theta,\ V_\varphi)^T$, $V_r=V,\ V_\theta=\Omega,\ V_\varphi=W$, and unit coordinate vectors $(\vec{r}), (\vec{\theta}), (\vec{\varphi})$, which define vector directions of corresponding equation lines, are in brackets after equations.

3.1 Birth of elementary particles from physical vacuum

Let's consider a spiral wave of photon (8)

$$w(\xi,t)\vec{m}=w_0\, e^{i(\omega_* t-k_*\xi)}\vec{m},\ \ \omega_*=k_*c,\ \xi=(\vec{n}\cdot\vec{r}),$$

propagating with the velocity c in physical vacuum in the direction of a vector $\vec{n}$ and having a wavelength $\lambda=2\pi/k_*$ and radius of the outer spiral $r_0=c/\omega_*=1/k_*$. Colliding with an obstacle (a field of an atomic nucleus or other photon), the wave is compressed in the direction of the vector $\vec{n}$ and bifurcated into a solution of the system of equations (14), in which the linear speed of rotation of the wave by the angle φ is equal to $W=(c/r_0)r\sin\theta$ (the direction of the axis z in (14) coincides with the direction of the vector $\vec{n}$). Such a solution of the system (14), describing the compressed or curled photon, as well as all other solutions, describing various elementary particles, we shall search among the solutions with zero coordinate of velocity vector by the angle θ.

So, we shall put in (14) $\Omega=0$ and result in **equation system of elementary particles:**

$$\begin{aligned}
&\frac{\partial\rho}{\partial t}+\frac{1}{\mathrm{r}^2}\frac{\partial(r^2\rho V)}{\partial r}+\frac{1}{\mathrm{r}\sin\theta}\frac{\partial(\rho W)}{\partial\varphi}=0,\\
&\frac{\partial(\rho V)}{\partial t}+V\frac{\partial(\rho V)}{\partial r}+\frac{W}{\mathrm{r}\sin\theta}\frac{\partial(\rho V)}{\partial\varphi}=0,\ (\vec{r})\\
&\frac{\partial(\rho W)}{\partial t}+V\frac{\partial(\rho W)}{\partial r}+\frac{W}{\mathrm{r}\sin\theta}\frac{\partial(\rho W)}{\partial\varphi}=0,\ (\vec{\varphi})
\end{aligned}\tag{15}$$

The solution for the curled photon we shall find from the system (15), putting in it $W=(c/r_0)r\sin\theta,\ V=0.$ Then we shall obtain $\rho=\rho_0(1+q_0(r)\exp(i(\omega_* t-\varphi)))$. That is, at curling the photon is transformed into a longitudinal wave of small compression - stretching of the density of physical vacuum, propagating on parallels inside a sphere of radius r_0 with constant angular velocity $\omega=\omega_*=c/r_0$. Curled photon has no mass and charge, so it can hypothetically apply for the role of neutrino though this hypothesis requires additional check and experimental confirmation.

Let's show now that equation system (15) has solutions, which possess all known properties of elementary particles when $r\le r_0$ is small enough. These solutions will be sought as waves propagating with constant angular velocity by the angle φ under the influence of small-amplitude oscillations of physical vacuum density

$$W=\frac{c}{r_0}r\sin\theta,\ \ \rho(r,\varphi,t)=\rho_0+q(r,\varphi,t)\tag{16}$$

and small-amplitude oscillations of function $V(r,\varphi,t)\ne 0$ when $r\le r_0$ is small enough. That is every elementary particle is some bifurcation from curled photon. Under such problem formulation, each elementary particle is a sphere of radius r_0, inside of which waves, created by small-amplitude oscillations of physical vacuum density, propagating along to any parallel (circle with radius $r\sin\theta, r\le r_0$) with constant angular velocity (frequency) c/r_0, making full roundabout way by angle $0 \le \varphi \le 2\pi$ over equal time $T = 2\pi r \sin\theta / W = 2\pi r_0 / c$. In addition, linear velocity of these waves increases linearly with the radius, reaching its maximum value (velocity of light c) on sphere's equator when $r = r_0$, $\sin\theta = 1$ (Fig.2).

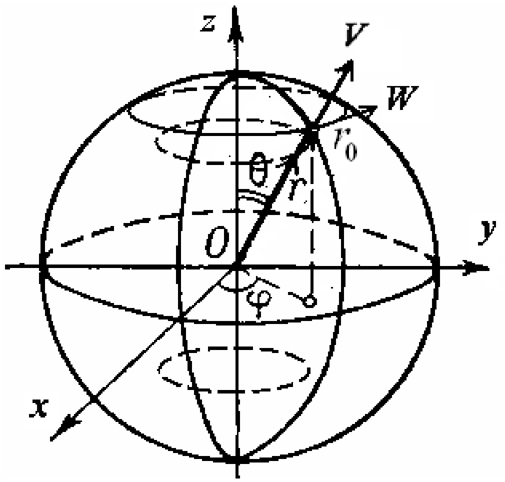

Fig. 2. Scheme of any elementary particle.

Substitution of assumed form of solution of (16) into equation system (15), with a drop of second infinitesimal order terms and multiplications of small terms, will result in the following system of equations

$$\begin{aligned} &\frac{\partial q}{\partial t} + \rho_0\left(\frac{\partial V}{\partial r} + \frac{2V}{r}\right) + \frac{c}{r_0}\frac{\partial q}{\partial \varphi} = 0, \\ &\frac{\partial V}{\partial t} + \frac{c}{r_0}\frac{\partial V}{\partial \varphi} = 0, \ (\vec{r}) \\ &\frac{\partial q}{\partial t} + \rho_0 \frac{V}{r} + \frac{c}{r_0}\frac{\partial q}{\partial \varphi} = 0, \ (\vec{\varphi}) \end{aligned} \tag{17}$$

It is necessary to notice that at such approximation nonlinear term of second infinitesimal order $V\,\partial(\rho V)/\partial r\,\vec{r}$ has been entirely neglected. The role of this term becomes significant only with relatively large $r \to \infty$ and, probably, with relatively small $r \to 0$. As it will be shown below, this term exactly generate gravitational field of a particle with relatively large r. It is rather probable, that the same term describes nuclear interactions at $r \to 0$.
It's not difficult to get the solutions of equation system (17) in the following form

$$V(r,\varphi,t) \approx \frac{V_0}{r} e^{i(\omega t - k r_0 \varphi)}, \ \omega = ck, \ \rho(r,\varphi,t) \approx \rho_0\left(1 - \frac{V_0 r_0}{c r^2} \varphi e^{i(\omega t - k r_0 \varphi)}\right). \tag{18}$$

However, not every solution in form (16), (18) is an elementary particle. Such solution has to possess properties of charge conservation and universality, as well as quantum properties of mass, momentum and energy. Moreover, over the time of full roundabout way of the wave along the sphere equator, electric field intensity must conserve its sign. Such classical and quantum mechanical terms as electric and magnetic field of elementary particle, its charge, mass, energy, momentum, spin also need correct definitions through the characteristics of physical vacuum.

First, let's give the definition of electric field and electric charge of elementary particle similarly to the case of plane electromagnetic waves propagation, examined above.

Definition. *Electric field intensity distribution* $\vec{E}$ *and charge density distribution* ρ_{ch} *of elementary particle will be defined as:*

$$\vec{E} = E\vec{r} = \frac{W}{r\sin\theta}\frac{\partial(\rho V)}{\partial\varphi}\vec{r};\ \rho_{ch} = \frac{1}{4\pi}div(V\frac{\partial(\rho W)}{\partial r}\vec{\varphi}). \tag{19}$$

It follows from (16) and (18) that inside a particle at $r \le r_0$

$$\vec{E} = E\vec{r} = \frac{c}{r_0}\frac{\partial(\rho V)}{\partial\varphi}\vec{r} \approx -\frac{ikr_0 c\rho_0 V_0}{r_0 r}e^{i(\omega t - kr_0\varphi)}\vec{r}\ ;\ \rho_{ch} \approx -\frac{ikc\rho_0 V_0}{4\pi r^2}e^{i(\omega t - kr_0\varphi)}. \tag{20}$$

Let's determine an instant value of the charge q_{ch} of elementary particle. Let $\omega t = 2\pi l + kr_0\varphi_*$, where $0 \le kr_0\varphi_* < 2\pi$. Integrating the density distribution of charge over sphere's volume with radius r_0 we shall obtain

$$q_{ch} = -\int_0^{\pi}\int_{\varphi_*}^{\varphi_*+2\pi}\int_0^{r_0}\frac{ikc\rho_0 V_0}{4\pi r^2}e^{i(kr\varphi_* - kr_0\varphi)}r^2\sin\theta\, dr d\varphi d\theta =$$

$$= \frac{c\rho_0 V_0}{2\pi}(e^{-i2\pi kr_0} - 1) = \begin{cases} 0,\ kr_0 = n/2,\ n = 2m,\ m = 0,1,... \\ -\frac{c\rho_0 V_0}{\pi},\ kr_0 = n/2,\ n = 2m+1. \end{cases} \tag{21}$$

What follows from formula (21) is that solution (16), (18) of the equation system (15) can be interpreted as an elementary particle only in such case, when wave number kr_0 is an integer or a half-integer value. For integer value of kr_0 the charge is zero, for any half-integer value of kr_0 charge equals common by modulus universal value $q = c\rho_0 V_0/\pi$.

Integrating the density distribution of charge over sphere's volume with radius r_0 for $\varphi_* - 2\pi \le \varphi \le \varphi_*$ we shall obtain positive value of particle charge q. Thus there are actually two particles bifurcating from curled photon (particle and antiparticle), which have the same frequencies $\omega = n\omega_*/2$ and charges, which modules are equal to q, but have opposite signs. In that case the wavelengths of created periodic solutions by the angle φ are less than 2π in half-integer value of times. That is time of the wave's full roundabout way by angle $0 \le \varphi \le 2\pi$ along any parallel of the sphere with radius r_0 equals integer number $2kr_0$ of half-periods $T_p = \pi/\omega = \pi/kc$ of physical vacuum density and electric field intensity oscillations, which conserves its sign on the last uneven half-period, being equal to the charge's sign.

It's important to point out that electric field of elementary particle directed along radius is created by particle's electric charge, but at the same time the charge is divergence of a completely different inner field of the particle, which is represented by second term in the third equation of equation system (15) and directed by the angle φ. Also notice that electric field intensity distribution of elementary particle inside the particle (that is within the sphere of radius r_0) defined by the third term in the second equation of equation system (15), decreases as $1/r$, so it removes the problem of infinite energy and mass of elementary particles.

3.2 Other basic properties of elementary particles

Let's now determine other properties of an elementary particle: internal energy *ε*, mass *m*, momentum *p* and spin *σ*. Expressions of Planck constant $\hbar$, as well as fine structure constant, which can be rightfully called the most mysterious constant of microcosm physics, will also be derived. First, let's determine internal energy formula with a use of expression of work *A*, executed by field forces of the particle

$$\frac{dA}{dt} = \int_B \Lambda \vec{F} \cdot \vec{W} dB. \tag{22}$$

Here B is the volume of elementary particle sphere of radius r_0, $\vec{F}$ is the field, which influences on charges distributed inside a sphere with distribution density Λ and has a nonzero projection on velocity vector $\vec{W}$, that is on direction of vector $\vec{\varphi}$. This field can not be electric field, which is directed along radius $\vec{r}$. This field can only be the summary field directed by angle $\vec{\varphi}$ from the third equation of system (15)

$$\vec{F} = V\frac{\partial(\rho W)}{\partial r}\vec{\varphi} + \frac{W}{r\sin\theta}\frac{\partial(\rho W)}{\partial\varphi}\vec{\varphi} \approx -ik\frac{c\rho_0 V_0 \sin\theta}{r}\varphi e^{i(\omega t - kr_0\varphi)}\vec{\varphi},$$

and it has to execute the work over not only electric charge with distribution density ρ_{ch}, but also over all other charges determined by divergence of this field. After determination of full charge distribution density

$$\Lambda = div\vec{F} = -\frac{ikc\rho_0 V_0}{r^2}\frac{\partial}{\partial\varphi}(\varphi e^{i(\omega t - kr_0\varphi)})$$

let's insert it as well as derived expression of internal field $\vec{F}$ into the formula (22) to get the following expression

$$\frac{dA}{dt} = -\int_B \frac{k^2 c^3 \rho_0{}^2 V_0{}^2 \sin^2\theta}{2r_0 r^2}\frac{\partial(\varphi e^{i(\omega t - kr_0\varphi)})^2}{\partial\varphi} dB =$$

$$= -e^{2i\omega t}\int_0^{\pi}\int_0^{2\pi}\int_0^{r_0}\frac{k^2 c^3 \rho_0{}^2 V_0{}^2 \sin^2\theta}{2r_0 r^2}\frac{\partial(\varphi^2 e^{-2ikr_0\varphi})}{\partial\varphi} r^2 \sin\theta dr d\varphi d\theta.$$

Integrating the last equation and taking into account that $\omega = kc$ one can obtain finally

$$A = ie^{2i\omega t}\frac{4kc^2\rho_0{}^2 V_0{}^2 \pi^2}{3};\ \varepsilon = |A| = \frac{4\pi^2}{3}kc^2\rho_0{}^2 V_0{}^2.$$

Now, to derive the well-known main formulas and correlations of quantum mechanics, it's suffice to denote the mass of elementary particle and Planck constant as

$$m = \frac{4\pi^2}{3} k\rho_0^2 V_0^2 = \frac{4\pi^2}{3} \omega\rho_0^2 V_0^2 \,/\, c; \quad \hbar = \frac{4\pi^2}{3} c\rho_0^2 V_0^2.$$

From this it follows immediately:

- Einstein's formula for internal energy of a particle and formulas of impulse and energy for de Broglie's waves

$$\varepsilon = mc^2, \quad p = mc = \hbar k, \; \varepsilon = \hbar\omega;$$

- formula for spin of a particle

$$\sigma = mcr_0 = \frac{4\pi^2}{3} kr_0 c\rho_0^2 V_0^2 = kr_0\hbar = \frac{n}{2}\hbar, \quad n = 0,1,2...$$

- fine structure constant formula

$$\alpha = \frac{q^2}{\hbar c} = \frac{c^2\rho_0^2 V_0^2}{\pi^2 4\pi^2 c^2 \rho_0^2 V_0^2 \,/\, 3} = \frac{3}{4\pi^4} \approx \frac{1}{130}.$$

These formulas, derived exclusively by the methods of classical mechanics, are completely identical to the well-known expressions of quantum mechanics as well as clearly reflect the physical essence of charge, mass, energy and spin of elementary particles, allowing to understand the nature of quantum processes in microcosm. It can be seen that the internal energy of the particle is indeed proportional to the square of velocity of light, and proportionality coefficient (mass of the particle) linearly grows with the increase of wave number k, as well as frequency ω of the parental photon. The Plank constant is indeed a constant value depending only on characteristics of physical vacuum and not on the type of the elementary particle. The spin of the particle indeed has a value of either integer or half-integer number of $\hbar$, which allows to separate all elementary particles in two general categories: bosons and fermions. Still, the most surprising and encouraging fact is the almost precise match of the fine structure constant α with its experimental value of 1/137.

Note also that the simplest particles with the spin of ½ when n = 1 are double period cycles in relation to the initial cycle defined by the motion of curled photon. That brings another proof of the theory introduced in this research – the interpretation of the Pauli principle, the corollary fact of which is that electron returns to the initial state only after the turn of 720, not 360 degrees. According to R. P. Feynman (Feynman & Weinberg, 1987), particle with topology of Moebius band meets the Pauli principle. But in the Feigenbaum-Sharkovskii-Magnitskii universal theory of dynamical chaos (FSM theory) (Magnitskii, 2008a, 2008b, 2009, 2010b, 2011b; Magnitskii & Sidorov, 2006; Evstigneev & Magnitskii, 2010), results of which valid for every nonlinear differential equation system of macrocosm, the solution's difficulty increase starts from double period bifurcation of the original singular cycle. Interesting enough, the newborn cycle of doubled period belongs to the Moebius band around the original cycle! In another words, according to the FSM theory electron and proton are initial and simplest double period bifurcations from the infinite bifurcation cascade. Therefore, FSM theory works not only in macrocosm, but also in microcosm, and elementary particles defined by formulas (16), (18), are not a full infinite set of all elementary particles, which can be born as a result of bifurcations in nonlinear equation system (15). Furthermore, more complex nonperiodic solutions of systems (14) and (15) can be foreseen, which are singular attractors in terms of FSM theory. Thus, any attempts of an experimental detection of the simplest (most elementary), as well as the most complex of elementary particles are essentially futile.

3.3 Some main classical equations and laws

Another proof of validity of the theory presented in this paper is the possibility of a rigorous mathematical conclusion from its unique postulate on existence of physical vacuum of some important phenomenological equations and laws of the modern physics which are widely used by classical electrodynamics and quantum mechanics and not contradicting to common sense interpretation of variables included in them. We consider here the Coulomb's law and Schrodinger's and Dirac's equations.

3.3.1 Coulomb's law

We assume that outside of a particle of radius r_0 change of density of physical vacuum practically does not occur. Then, neglecting the third equation of (17), we shall obtain, that at $r > r_0$

$$V(r,\varphi,t) \approx \frac{V_0 r_0}{r^2} e^{i(\omega t - k r_0 \varphi)},\ \omega = ck,\ r > r_0.$$

The vector of electric field intensity distribution of a particle will become

$$\vec{E} = E\vec{r} \approx -\frac{ik r_0 c \rho_0 V_0}{r^2} e^{i(\omega t - k r_0 \varphi)} \vec{r}. \tag{23}$$

Then a vector of electric field intensity of an elementary particle $\vec{E}(r)$ we shall find, averaging instant value of a vector of intensity distribution by the angle φ. Let $\omega t = 2\pi l + k r_0 \varphi_*$, where $0 \le k r_0 \varphi_* < 2\pi$. Then for the particles having a negative charge $-q$, we shall obtain

$$\vec{E}_- = -\frac{1}{2\pi} \int_{\varphi_*}^{\varphi_* + 2\pi} \frac{ik r_0 c \rho_0 V_0}{r^2} e^{i(kr\varphi_* - k r_0 \varphi)} \vec{r} d\varphi = -\frac{c\rho_0 V_0}{\pi r^2} \vec{r} = -\frac{q}{r^2} \vec{r}.$$

For the particles having a positive charge $+q$, averaging of instant value of a vector of electric field intensity distribution by the angle φ in the interval $\varphi_* - 2\pi \le \varphi \le \varphi_*$ will give $\vec{E}_+ = (q / r^2)\vec{r}$. Obtained expressions coincide with expressions for intensity of an electric field of a charge in the Coulomb's law, and for a particle having a negative charge, the vector of electric field intensity is directed on radius to the center of a particle, and for a particle having a positive charge, the vector of electric field intensity of a particle is directed on radius from its center.

3.3.2 Schrodinger's equation

Let's show, that for a free particle of mass m the solution of the Schrodinger's equation

$$i\hbar \frac{\partial \psi}{\partial t} = -\frac{\hbar^2}{2m} \Delta \psi \tag{24}$$

is a scalar function $E^*(r,\varphi,t)$, which is a complex conjugate function to an electric field intensity distribution function of an elementary particle from expression (20). As

$$\frac{\partial E^*}{\partial t}=-i\omega E^*,\ \frac{\partial^2 E^*}{\partial\varphi^2}=-k^2{r_0}^2E^*,\ \frac{\partial E^*}{\partial t}=\frac{i\omega}{k^2r_0^2}\frac{\partial^2 E^*}{\partial\varphi^2}=\frac{i\omega}{k^2r_0^2}r^2\sin^2\theta\,\Delta E^*,$$

then averaging the right part of last expression by the angle θ, we shall obtain in a neighborhood of a sphere of an elementary particle of radius r_0

$$\frac{\partial E^*}{\partial t}\approx\Big(\frac{1}{\pi}\int_0^\pi\frac{i\omega}{k^2}\sin^2\theta\,d\theta\Big)\Delta E^*=i\frac{c^2}{2\omega}\Delta E^*.$$

Multiplying the last expression on $i\hbar$ we shall obtain

$$i\hbar\frac{\partial E^*}{\partial t}=-\frac{c^2\hbar}{2\omega}\Delta E^*=-\frac{\varepsilon\hbar}{2\omega m}\Delta E^*=-\frac{\omega\hbar^2}{2\omega m}\Delta E^*=-\frac{\hbar^2}{2m}\Delta E^*,$$

that coincides with the equation (24). Thus, it becomes clear a physical sense of ψ - function in the Schrodinger's equation for a free particle - it is the electric field intensity distribution of an elementary particle near the surface of its sphere.

3.3.3 Dirac's equation

It was already shown in (Magnitskii, 2010a, 2011a) that electric field intensity and charge of elementary particle defined above agree with electromagnetic form of Dirac's equation for electron in bispinor form. Here we shall consider this question in more detail. Dirac's equation in bispinor form has a kind

$$i\hbar\frac{\partial\psi}{\partial t}(\vec r,t)=\Big(c\sum_{j=1}^{3}\alpha_j p_j+\alpha_0 m_e c^2\Big)\psi(\vec r,t),\tag{25}$$

that is a consequence of operator equation

$$\hat\varepsilon^2\psi=c^2\vec p^2\psi+m_e{}^2c^4\psi,\quad \hat\varepsilon=i\hbar\frac{\partial}{\partial t},\ \vec p=-i\hbar\vec\nabla,\tag{26}$$

where m_e is mass of electron or other fermion, $\hat\varepsilon$ and $\vec p$ are operators of energy and momentum and α_j – Dirac's matrixes. In the theory of electrodynamics of curvilinear waves (EDCW) of A.Kyriakos (Kyriakos, 2006) the electromagnetic form of Dirac's equation is deduced. It is shown, that if the electromagnetic wave of a photon is propagating in a direction z, then at its hypothetical curling and a birth from it a pair of elementary particles the 4-vector (E_x,E_y,H_x,H_y) of electromagnetic wave of each of particles satisfies the Dirac's equations in bispinor form. So, to show, that the vector function of electric field intensity distribution of an elementary particle in a vicinity of its equator satisfies the equations (25) and (26) we should write down system of the equations of elementary particles (15) in cylindrical system of coordinates which axis z coincides with the axis of rotation of an elementary particle:

$$\frac{\partial\rho}{\partial t}+\frac{1}{\mathrm{r}}\frac{\partial(r\rho V)}{\partial r}+\frac{1}{\mathrm{r}}\frac{\partial(\rho W)}{\partial\varphi}=0,$$
$$\frac{\partial(\rho V)}{\partial t}+V\frac{\partial(\rho V)}{\partial r}+\frac{W}{\mathrm{r}}\frac{\partial(\rho V)}{\partial\varphi}=0,\ (\vec{r}) \quad (27)$$
$$\frac{\partial(\rho W)}{\partial t}+V\frac{\partial(\rho W)}{\partial r}+\frac{W}{\mathrm{r}}\frac{\partial(\rho W)}{\partial\varphi}=0,\ (\vec{\varphi})$$

Solution of the system (27), consistent with a solution of the system (19) in the vicinity of the equatorial areas of the elementary particle, has the following kind:

$$W=(c/r_0)r,\ V(r,\varphi,t)\approx V_0e^{i(\omega t-kr_0\varphi)},\ \omega=ck,\ \vec{E}=\frac{c}{r\,r_0}\frac{\partial(\rho V)}{\partial\varphi}\vec{r}=E\vec{r}.$$

Then, as it is easy to verify by the direct substitution, the vector $\vec{E}$ is an approximate solution of the second order equation

$$\frac{\partial^2\vec{E}}{\partial t^2}-c^2\nabla^2\vec{E}+\omega_p^2\vec{E}=0.$$

in the vicinity of $r\approx r_0$, where ∇^2 is Laplace operator in cylindrical coordinate system and the frequency $\omega_p=c/r_0$ is an angular velocity, which can be interpreted as an oscillation frequency of the curled photon electromagnetic wave with a wavelength $\lambda=2\pi r_0$. Multiplying the obtained equation by $(i\hbar)^2$ and using the relation $\hbar\omega=mc^2$, we obtain for vector $\vec{E}$ an equation

$$\hat{\varepsilon}^2\vec{E}=c^2\hat{\vec{p}}^2\vec{E}+m_p{}^2c^4\vec{E}. \quad (28)$$

Equation (28) differs from the equation (26) those, that in it instead of the electron mass m_e there is the mass of the curled photon $m_p=2m_e$ until the moment of its division into two particles: an electron and a positron. Hence, the vector of electric field intensity distribution of each separate elementary particle after their division is the solution of equations (25) and (26) written in cylindrical system of coordinates.

Therefore, the true physical meaning of wave function ψ from Dirac equation for electron in bispinor form (25) becomes clear – it's a 4-vector (E_x,E_y,H_x,H_y) of particle's electromagnetic wave, but in such elementary particles model, as opposed to the case of plain electromagnetic waves propagation, magnetic field intensity vector is a virtual one, since it is directed on an axis z, while velocity vector component V_z equals to zero. Therefore, there is no real magnetic field of an elementary particle in a considered model.

3.4 Electron, positron, proton, antiproton, neutron and atom of hydrogen

It's obvious, that more complex, multi-curled elementary particles correspond to high-frequency perturbation waves with bigger mass and energy. So, it's natural to imply that the simplest half-curled particles with the spin of ½ when n = 1 are pairs "electron-positron" and "proton-antiproton". Both pairs of particles have the same mechanism of a birth. The difference is in the values of frequencies of parental photons and, accordingly, in radiuses of their curling r_0 and in masses of the born particles. Experimental data testify that the mass of proton is in three orders greater than the mass of electron. Consequently, the wave frequency of proton is in three orders greater than the wave frequency of electron and, that is important, the radius of proton is in three orders smaller than the radius of electron. That is, the electron is not a small particle that rotates around the nucleus of an atom, and it is a huge ball which size is comparable to the size of the crystal lattice of substance. This implies that the current in the conductors can not be a movement of free electrons.

It is obvious that the charges of proton and electron should have different signs. Thus, their combinations can form atoms of substance only in the case when the electric field intensity of a particle of smaller radius (proton) is directed to its center, and, accordingly, the electric field intensity of a particle of the greater radius (electron) is directed from its center. That is, proton should have a negative charge in the sense of expression (20), and electron should have a positive charge. Then for instant density of physical vacuum of proton ρ_p inside a sphere with radius of its curling r_p we shall obtain the expression

$$\operatorname{Re}\rho_p = \operatorname{Re}\frac{1}{2\pi}\int_{\varphi_*}^{\varphi_*+2\pi} \rho_0(1-\frac{r_p c V_0}{cr^2}\varphi e^{i(kr\varphi_* - k r_0 \varphi)})d\varphi = \rho_0(1+\frac{4V_0 r_p}{\pi c r^2}) > \rho_0.$$

Similar expression we shall receive for instant density of physical vacuum of electron ρ_e inside a sphere with radius of its curling r_e:

$$\operatorname{Re}\rho_e = \operatorname{Re}\frac{1}{2\pi}\int_{\varphi_*-2\pi}^{\varphi_*} \rho_0(1-\frac{r_e c V_0}{cr^2}\varphi e^{i(kr\varphi_* - k r_0 \varphi)})d\varphi = \rho_0(1-\frac{4V_0 r_e}{\pi c r^2}) < \rho_0.$$

Consequently, proton is compressed, and electron is rarefied areas of physical vacuum with respect to its stationary density ρ_0. Elementary antiparticles positron and antiproton are, obviously, in pairs to electron and proton, and have charges of opposite signs, that is their waves are formed by additional half-periods of the waves of double period with respect to the waves of the original photons.

Consider now the possibility of the formation from a pair of proton-electron of the simplest electrically neutral structures, such as neutron and atom of hydrogen. Since the electron has a much larger radius than the radius of a proton, then in the most part of elements of physical vacuum laying inside of the electron, the electric field of the electron directed from its center, less than an electric field of the proton directed to its center. Therefore, an electron having got in area of its capture by an electric field of a proton, should move in its direction until some stable structure in the form of a sphere with a radius of an electron, in which center there is a nucleus as a sphere with a radius of a proton is formed. The electric field intensity outside of an external sphere is equal to zero, as at $r > r_e$

$$\vec{E} = E\vec{r} = \vec{E}_e + \vec{E}_p = \frac{q}{r^2}\vec{r} - \frac{q}{r^2}\vec{r} = 0,\ r > r_e.$$

We can assume that the simplest atom of hydrogen, as well as arbitrary neutron are arranged in this manner. The neutron can differ from the atom of hydrogen in radius and, accordingly, in frequencies of oscillations of waves of its electron and proton. In Fig. 3 a diagram of a hydrogen atom and also a picture of a real hydrogen atom made in Japan (Podrobnosti, 04.11.2010) are presented.

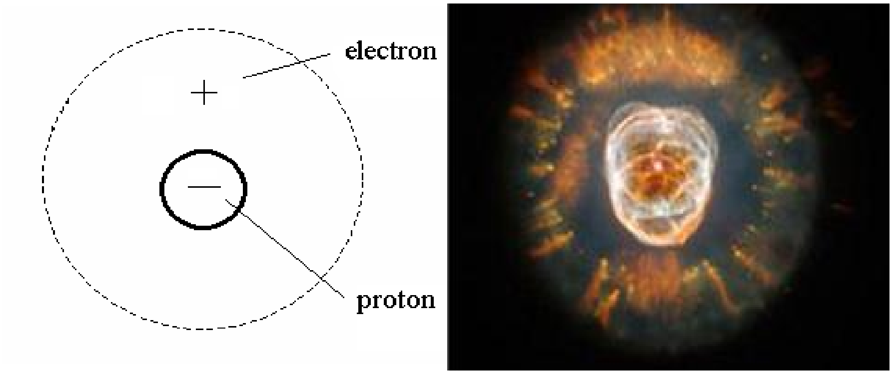

Fig. 3. The scheme (at the left) and the photo of a real hydrogen atom.

In this model, the impossibility of formation of atoms of antimatter can be easily explained by the fact that the electric field of the antiproton, which has much smaller radius than the positron, is directed from its center, which prevents the formation of stable structures of antimatter.

4. Gravitation and gravitational waves

Let's demonstrate that the creation of any elementary particle is accompanied by appearance of the gravitation, notably the pressure force in physical vacuum, generated by small periodic perturbations of its density, which in its own turn generate gravitational wave, propagating to the center of newborn particle. It's natural to propose that gravitation works over any distance from the particle, and that when the distance is large, perturbations of physical vacuum density created by the newborn particle depend only on distance r and are independent of angles θ and φ. Based on such assumption, let's seek solutions of system (15) when r is large in the following form:

$$\rho = \rho_0 + q(r,t),\ V = V(r,t),\ W = 0.$$

Equation system (15) will take a form

$$\frac{\partial \rho}{\partial t} + \frac{1}{r^2}\frac{\partial (r^2 \rho V)}{\partial r} = 0,\ \frac{\partial (\rho V)}{\partial t} + V\frac{\partial (\rho V)}{\partial r} = 0, \tag{29}$$

meaning that of all four fields in the initial system (15) only gravitational field $G = V\partial(\rho V)/\partial r$ will remain significant when r is large enough.

Furthermore, gravitational field differs from three other previously examined fields since it's severely nonlinear. It can't be linearized basing on the form of velocity W component in analogue with electric and two internal fields of the particle. When r is small and, consequentially, V is small as well, gravitational field can be neglected during the formulation of elementary particles theory. On the contrary, when r is relatively large, all other fields with the exception of gravitational are can be neglected, and that agrees with experimental data. But when $r \to 0$ V again starts to grow and so we can propose that gravitational term describes also nuclear interactions.

Let's seek the solution of equation system (29) in the form of $V = c / r^2$, that is in the form of a gravitational (radial) wave, which propagates to the center of elementary particle $(r = 0)$ with velocity dependant on radius. With the use of function V in equation system (29) and in case of $r \to \infty$ next expression for small oscillation of physical vacuum density will be derived

$$\rho(r,t) \approx \rho_0(1 + q(r,t)) = \rho_0(1 + q_0 e^{i(\omega t + kr^3/3)}),\ \omega + kc = 0.$$

In this case the pressure force of gravitational wave (gravitational field intensity) expresses as

$$G = V\frac{\partial(\rho V)}{\partial r} \approx \frac{c^2}{r^4}\frac{\partial q}{\partial r} = \frac{iq_0 kc^2}{r^2} e^{i(\omega t + kr^3/3)},$$

and it agrees with the law of universal gravitation. However, the physical essence of gravitation comes in somewhat different light than before. The bodies do not attract each other – each material body creates its own gravitational wave, which propagates from infinity to its center of mass and puts an external pressure on other body with the force, proportional to the mass of the body and inversely proportional to the square of distance between the bodies.

Let's note another significant difference between gravitational and electromagnetic waves. Electromagnetic wave moving with constant velocity has a wavelength, thus, resulting in the existence of electromagnetic wave quant or photon. Gravitational wave moves with velocity dependant on radius, thus, there can be no gravitational wave quant. Traditional parallel between the gravitational wave and its hypothetical carrier, graviton, is apparently the main obstacle for the real discovery of gravitational waves in nature.

5. Conclusion

The theoretical research carried out in the work and its results allow to draw several fundamental conclusions and statements which looks more than plausibly:

- all fields and material objects in the Universe are various perturbations of physical vacuum, microcosm and macrocosm are organized by the same laws – laws of classical mechanics, described by nonlinear differential equation systems in tree-dimensional plane Euclidean space and bifurcations in such systems;
- electromagnetic fields can exist without mass and gravitation, and electromagnetic waves can propagate in any direction with constant velocity (velocity of light) and arbitrary oscillation frequency, which is defined by oscillation frequency of physical vacuum without changes of its density;
- there exist equations, more common than Maxwell equations, deduced from the physical vacuum equations and invariant concerning Galileo transformations, many experimentally established laws of classical and quantum mechanics can be successfully deduced from the physical vacuum equations;
- existence of gravitation, mass and charge inseparably linked with the creation of elementary particles in form of curls of a single gravi-electromagnetic field, the attracting force is actually a pressure force in physical vacuum created by gravitational wave, which propagates to the center of the particle with variable velocity and has no wave length;

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