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MATHEMATICAL THEORY OF PHYSICAL VACUUM

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This monograph sets out mathematical basics of unifying fundamental physical theory, with a single postulate of nonvoid physical vacuum. It will be shown that all basic equations of classical electrodynamics, quantum mechanics and gravitation theory could 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. Through the characteristics of physical vacuum, namely its density and propagation velocity of various density's perturbations, such principal physical conceptions as matter and antimatter, velocity of light, electron, photon and other elementary particles, internal energy, mass, charge, spin, quantum properties, Planck constant and fine structure constant will have clear and sane definitions.

The monograph is dedicated to the reading public interested in agenda of modern physics and cognition of the environment.

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. 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. Moreover, some conclusion drawn out of modern physics equations contradict experimental data and are outright absurd, e.g. infinite energy or mass of point charge. Naturally, any theory with a claim of being fundamental has to answer all of the questions stated above. Besides, in our opinion such kind of theory should be consistent and follow the common sense.

This research goal is a brief formulation of basics of such unifying fundamental physical theory with a single postulate: existence of nonvoid physical vacuum. As in next sections will be shown, 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, all principal physical conceptions from above will have clear and sane definitions through the parameters of physical vacuum, namely its density and propagation velocity of various density's perturbations. Thereby, it will be 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. To find the solution of resulting nonlinear partial differential equation asymptotic methods and methods of bifurcation theory for nonlinear differential equation systems will be used.

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 $\vec{x} = (x_1, x_2, x_3)^T$, **having in every time station** t **density** $\rho(\vec{x}, t)$ **and perturbation propagation velocity vector** $\vec{u}(\vec{x}, t) = (u_1(\vec{x}, t), u_2(\vec{x}, t), u_3(\vec{x}, t))^T$ **.**

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 $\rho = \rho_0 + q(\vec{x}, t)$ should be as follows:

$$\frac{\partial \rho}{\partial t} + div\,(\rho_0 \vec{u} + q\vec{u}) = 0, \qquad (0.1)$$

$$\frac{\partial(\rho_0 \vec{u} + q\vec{u})}{\partial t} + (\vec{u} \cdot \nabla)(\rho_0 \vec{u} + q\vec{u}) = 0, \qquad (0.2)$$

where first equation is an equation of continuity, and second is the momentum equation. For the description of unitary physical picture of the world other equations won't be needed.

1. Electrodynamics of physical vacuum

Let's consider a case in which perturbation propagation velocity $\vec{u}$ has a certain direction set by vector $\vec{n}$.

Definition 1. *Electric field intensity $\vec{E}$ and magnetic field intensity $\vec{H}$ will be defined as next vector values:*

$$\vec{H} = c\,rot\,(\rho\,\vec{u}), \quad \vec{E} = c(\vec{n}\cdot\nabla)(\rho\,\vec{u}) \qquad (1.1)$$

Definition 2. *Current density $\vec{j}$ and charge density ρ_{ch} will be expressed through density of physical vacuum and longitudinal component v of density perturbation propagation velocity*

$$\vec{j} = v\rho_{ch}\vec{n}, \qquad \rho_{ch} = \frac{1}{4\pi}\,div\,\vec{E}. \qquad (1.2)$$

Substitution of expressions (1.1)-(1.2) into equations (0.1) and (0.2) and several consequential manipulations will result in nonlinear equation system of physical vacuum electrodynamics in the following form

$$\frac{\partial\vec{E}}{\partial t} - v\,rot\,\vec{H} + \frac{\partial v}{\partial(\vec{x}\cdot\vec{n})}\vec{E} + 4\pi\,\vec{j} = 0, \quad div\vec{E} = 4\pi\rho_{ch}, \qquad (1.3)$$

$$\frac{\partial\vec{H}}{\partial t} + v\,rot\,\vec{E} + \frac{\partial v}{\partial(\vec{x}\cdot\vec{n})}\vec{H} = 0, \quad div\vec{H} = 0. \qquad (1.4)$$

In the simplest particular case when the solutions of equation system (0.1)-(0.2) are constants $\rho = \rho_0$ and $v = c = const$, equation system (1.3)-(1.4) turns into classical Maxwell-Lorentz equation system for electromagnetic field in vacuum

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

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

In other words, this case defines small-amplitude oscillations of physical vacuum with constant density, in transverse direction to vector $\vec{n}$, with perturbation propagation velocity c in direction $\vec{n}$. Therefore, vectors of electric and magnetic field intensities, which are solutions of classical Maxwell-Lorentz equation system for electromagnetic field in vacuum, are indeed proportional to directional derivative and rotor (curl) of transverse velocity of physical vacuum small-amplitude oscillations propagation in simplest incompressible case. And constant c is indeed the velocity of light in classic interpretation, which is a propagation velocity of transverse wave, created by oscillations of physical vacuum of constant density.

Next particular solution of equation system (1.3)-(1.4) is a case of small-amplitude oscillations of physical vacuum density $\rho = \rho_0 + q(\vec{x}, t)$ with constant propagation velocity of its longitudinal perturbations $v(\vec{x}, t) = c$. In other words, this case defines small-amplitude oscillations of physical vacuum with variable density, in transverse direction to vector $\vec{n}$, with constant perturbation propagation velocity c in direction $\vec{n}$. In this case equation system (1.3)-(1.4) turns into classical Maxwell-Lorentz equation system for electromagnetic field with presence of charges

$$\frac{\partial \vec{E}}{\partial t} - c\, rot\, \vec{H} + 4\pi\, \vec{j} = 0, \quad div\, \vec{E} = 4\pi\rho_{ch}, \qquad (1.5)$$

$$\frac{\partial \vec{H}}{\partial t} + c\, rot\, \vec{E} = 0, \quad div\, \vec{H} = 0. \tag{1.6}$$

The essence of charge density in classical Maxwell-Lorentz equation system (1.5)-(1.6) became clear now. The charge density is created solely by density oscillations of physical vacuum in compliance with formula (1.2), and is absent in case of oscillations of physical vacuum with constant density.

But equation system (1.3)-(1.4) also have solutions which do not solve classical Maxwell-Lorentz equation system (1.5)-(1.6). This is a case of small-amplitude oscillations of physical vacuum density $\rho = \rho_0 + q(\vec{x}, t)$, when propagation velocity of its longitudinal perturbations also periodically oscillates in vicinity of its constant value $v = c + \psi(\vec{x}, t)$. Such solutions can only be found from generalized nonlinear equation system of physical vacuum electrodynamics (1.3)-(1.4) or directly from solution of nonlinear equation system (0.1)-(0.2). The existence of such formally unknown solutions indicates the fundamental possibility for theoretical description of multiple experiments of electromagnetic (free) energy extraction from physical vacuum, which, in particular, were carried out by LLC "New Inflow" and contradict laws of classical electrodynamics.

2. Theory of elementary particles

Let's express equation system of physical vacuum dynamics (0.1)-(0.2) through spherical coordinates and consider only specific solutions of resulting equation system, in which component V_θ of perturbation propagation velocity $\vec{u}$ by radius r and angles θ, φ equals zero. Other components will be designated as $V_r = V$, $V_\varphi = W$. This will result in *physical equation system of elementary particles:*

$$\frac{\partial \rho}{\partial t} + \frac{1}{r^2}\frac{\partial(r^2 \rho V)}{\partial r} + \frac{1}{r\sin\theta}\frac{\partial(\rho W)}{\partial \varphi} = 0,$$

$$\frac{\partial(\rho V)}{\partial t} + V\frac{\partial(\rho V)}{\partial r} + \frac{W}{r\sin\theta}\frac{\partial(\rho V)}{\partial \varphi} = 0, \ (\vec{r}) \ (2.1)$$

$$\frac{\partial(\rho W)}{\partial t} + V\frac{\partial(\rho W)}{\partial r} + \frac{W}{r\sin\theta}\frac{\partial(\rho W)}{\partial \varphi} = 0, \ (\vec{\varphi})$$

Unit coordinate vectors $(\vec{r})$, $(\vec{\varphi})$, which define vector directions of corresponding equation lines, are in brackets after equations. As it will be shown, equation system (2.1) has solutions, which possess all known properties of elementary particles when r is small. 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:

$$W = \frac{c}{r_0}r\sin\theta, \ \ \rho(r,\varphi,t) = \rho_0 + q(r,\varphi,t). \tag{2.2}$$

Here and in (2.1) functions $V(r,\varphi,t)$, $q(r,\varphi,t)$ are both small when r is small. Under such problem formulation, each elementary particle is 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 $r = r_0$, $\sin\theta = 1$.

Substitution of assumed form of solution of (2.2) into equation system (2.1), with a drop of second infinitesimal order terms and multiplications of small terms, will result in the following

$$\frac{\partial q}{\partial t} + \rho_0 \frac{\partial V}{\partial r} + \frac{2\rho_0 V}{r} + \frac{c}{r_0} \frac{\partial q}{\partial \varphi} = 0,$$

$$\frac{\partial V}{\partial t} + \frac{c}{r_0} \frac{\partial V}{\partial \varphi} = 0, \ (\vec{r}) \tag{2.3}$$

$$\frac{\partial q}{\partial t} + \rho_0 V / r + \frac{c}{r_0} \frac{\partial q}{\partial \varphi} = 0. \ (\vec{\varphi})$$

It's worth a notion that at such approximation nonlinear term of second infinitesimal order $V \frac{\partial(\rho V)}{\partial r} \vec{r}$ has been entirely neglected. As it will be shown below, this term exactly generate gravitational field of a particle, but its role becomes significant only with relatively large r. It's not difficult to get the solutions of equation system (2.3) in the following form

$$V(r,\varphi,t) \approx \frac{V_0}{r} e^{i(\omega t \pm kr_0\varphi)}, \ \omega \pm ck = 0, \tag{2.4}$$

$$\rho(r,\varphi,t) \approx \rho_0 (1 - \frac{V_0 r_0}{cr^2} \varphi \, e^{i(\omega t \pm kr_0\varphi)}). \tag{2.5}$$

Solutions of (2.2), (2.4)-(2.5) are propagations of two waves by angle φ along parallels of sphere with radius r in positive and negative direction with constant angular velocity, which equals modulo c/r_0, and created by periodic compressions and extensions of physical vacuum density. However, not every solution in form (2.2), (2.4)-(2.5) 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 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 3. *Electric field intensity* $\vec{E}$ *and charge density* ρ_{ch} *of elementary particle will be defined as:*

$$\vec{E} = E\vec{r} = \frac{c}{r}\frac{\partial(\rho V)}{\partial\varphi}\vec{r} \approx \frac{c\rho_0}{r}\frac{\partial V}{\partial\varphi}\vec{r} = \pm\frac{ikr_0 c\rho_0 V_0}{r^2}e^{i(\omega t \pm kr_0\varphi)}\vec{r}, \quad (2.6)$$

$$\rho_{ch} = \frac{1}{4\pi}div(V\frac{\partial(\rho W)}{\partial r}\vec{\varphi}) \approx \pm\frac{ikc\rho_0 V_0}{4\pi r^2}e^{i(\omega t \pm kr_0\varphi)}. \quad (2.7)$$

It's worth a notion that like in the case of plane electromagnetic waves, electric field intensity vector is only a linearization of a real field vector $\frac{W}{r\sin\theta}\frac{\partial(\rho V)}{\partial\varphi}\vec{r}$ and coincides with it only on equator of the sphere with radius r_0. Let's determine the charge q_{ch} of elementary particle, integrating the stationary density distribution of charge over sphere's volume with radius r_0:

$$q_{ch} = \pm\int_0^\pi\int_0^{2\pi}\int_0^{r_0}\frac{ik\,c\rho_0 V_0}{4\pi\,r^2}e^{\pm ik\,r_0\varphi}r^2\sin\theta\,dr d\varphi d\theta =$$

$$= \frac{c\rho_0 V_0}{2\pi}(e^{\pm i2\pi k r_0} - 1) = \begin{cases} 0, kr_0 = n/2, \ n = 2m, \ m = 0,1,... \\ -\frac{c\rho_0 V_0}{\pi}, \ kr_0 = n/2, \ n = 2m+1. \end{cases} \quad (2.8)$$

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What follows from formula (2.8) is that solution (2.2), (2.4)-(2.5) of the equation system (2.3) 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 value $c\rho_0 V_0/\pi$, which is negative when wave is propagating in direction of angle φ increment (c has a positive sign), and positive when wave is propagating in opposite direction (c has a negative sign). Furthermore, time of the wave's full roundabout way by angle $0 \leq \varphi \leq 2\pi$ 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 oscillations and electric field intensity, which conserves its sign on the last uneven half-period, being equal to the charge's sign.

Notice that resulting solution can be interpreted as photon bifurcation with wavelength $\lambda = 2\pi/k$, curled around the circle with radius $r_0 = 1/k$ in such way, that its wavelength equals the circle's perimeter. It is obvious that equation system (2.3) has such solution with $\rho = \rho_0 + q_0 e^{i(\omega t \pm kr_0 \varphi)}$, $V = 0$. Therefore the creation of any elementary particle can be treated as its bifurcation from the periodic solution of equation system (2.3), corresponding to curled photon with appropriate wavelength. In that case the wavelength of created periodic solution is less than corresponding photon's wavelength in half-integer value of times. It's worth a notion that there are actually two particles bifurcating from photon (particle and antiparticle), which correspond to the pair of waves, propagating along the sphere's parallels in opposite directions.

Let's indicate now that electric field intensity and charge of elementary particle defined above agree with electromagnetic form of Dirac equation for electron. With that goal in mind, let's define magnetic field intensity vector in analogue with the case of plane electromagnetic waves propagation. Naturally, it will correspond with already defined electric field intensity vector:

$$\vec{H} = c\sin\theta\, rot\,(\rho V\vec{r}) = \frac{c}{r}\frac{\partial(\rho V)}{\partial\varphi}\vec{\theta}, \ \left|\vec{H}\right| = \left|\vec{E}\right|.$$

Let's stipulate that 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's aligned by angle θ, while velocity vector component V_θ over this angle equals zero. Therefore, there is no real magnetic field of an elementary particle.

The second equation of system (2.1), with ignorance of the second (gravitational) term, will result in

$$\frac{\partial\vec{H}}{\partial t} + W\,rot\vec{E} = 0, \quad \frac{\partial\vec{E}}{\partial t} - W\,rot\vec{H} - \frac{W}{r}E\vec{\varphi} = 0.$$

The last equation on the equator of radius r_0, will take following form

$$\frac{\partial\vec{E}}{\partial t} - c\,rot\,\vec{H} - i\frac{c}{r_0}\vec{E} = 0\,(\vec{r}), \tag{2.9}$$

that is identical to the electromagnetic form of Dirac equation [1]. In this case frequency in equation (2.9) is an angular velocity $\omega = c/r_0$, which can be interpreted as an oscillation frequency of the curled photon electromagnetic wave with a wavelength $\lambda = 2\pi r_0$. Furthermore, since $cE/r_0 = 4\pi c\rho_{ch}$ and $c\rho_{ch}\vec{\varphi} = \vec{j}$, the equation (2.9) can be laid down in the following form

$$\frac{\partial\vec{E}}{\partial t} - c\,rot\,\vec{H} + 4\pi\,\vec{j} = 0,$$

that is identical to the corresponding equation of physical vacuum electrodynamics with the only difference that the directions of currents inside the elementary particle are orthogonal to the direction of electric field intensity vector. It's not difficult to get the second order wave equations of vector $\vec{E}$:

$$\frac{\partial^2 \vec{E}}{\partial t^2} - c^2 \nabla^2 \vec{E} + \omega^2 \vec{E} = 0 \quad or \quad \hat{\varepsilon}^2 \vec{E} = c^2 \vec{p}^2 \vec{E} + m^2 c^4 \vec{E}.$$

where $\hat{\varepsilon} = i\hbar \dfrac{\partial}{\partial t}$, $\vec{p} = -i\hbar \vec{\nabla}$ are operators of energy and momentum, and

$mc^2 = \hbar\omega$. Therefore, the true physical meaning of wave function ψ from Dirac equation for electron in bispinor form becomes clear – it's a vector of particle's electromagnetic wave, magnetic field in such case is exclusively virtual, and electric field intensity vector is defined by linearized form of the field, which were introduced as the last term of second equation in equation system (2.1). It's important to point out that outer 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 and third terms in the third equation of equation system (2.1) and directed by angle $\vec{\varphi}$. Also notice that outer electric field intensity of elementary particle decreases with the distance from center of the particle as $1/r^2$, and that agrees with Coulomb law, but inside the particle (that is within the sphere of radius r_0) the intensity of a real (not linearized) electric field, defined by second term in the second equation of equation system (2.1), decreases as $1/r$ (!), so it removes the problem of infinite energy and mass 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

$$\frac{dA}{dt} = \int_B \Lambda \vec{F} \cdot \vec{W} dB, \tag{2.10}$$

Here B is the volume of elementary particle sphere of radius r_0, $\vec{F}$ is the field, which influences charges distributed inside a sphere, with distribution density Λ and possessing nonzero projection on velocity vector $\vec{W}$, that is on direction of vector $\vec{\varphi}$. This field is neither electric field, which is directed along radius $\vec{r}$, nor it's the field $E_{\vec{\varphi}}$ from the Dirac representation (2.9), since it's exclusively virtual (ephemeral) field. This field can only be the summary field directed by angle $\vec{\varphi}$ from the third equation of system (2.1)

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

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

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

let's insert it as well as derived expressions of internal field $\vec{F}$ and full charge of the particle into the formula (2.10) to get the following expression of the work A

$$A = \frac{i}{4} \int_B \frac{kc^2 \rho_0{}^2 V_0{}^2 \sin^2\theta}{r_0 r^2} \frac{\partial(\varphi\, e^{i(\omega t \pm kr_0 \varphi)})^2}{\partial \varphi} dB.$$

Since the work executed by the field $\vec{F}$ over the charges inside the particle equals the decrement of the field's energy, it means that field $\vec{F}$ as well as particle itself possess internal energy, density of which on the sphere B expressed by formula

$$\frac{kc^2 \rho_0{}^2 V_0{}^2 \sin^2\theta}{4r_0 r^2} \frac{\partial(\varphi^2 e^{\pm 2ikr_0 \varphi})}{\partial \varphi}.$$

Full quantity of particle's internal energy can be found as its density integral over the volume of the sphere

$$\varepsilon = \frac{1}{4r_0} \int\limits_0^\pi \int\limits_0^{2\pi} \int\limits_0^{r_0} \frac{kc^2\rho_0^2 V_0^2 \sin^2\theta}{r^2} \frac{\partial(\varphi^2 e^{\pm 2ikr_0\varphi})}{\partial\varphi} r^2 \sin\theta \, dr d\varphi d\theta = \frac{4\pi^2}{3} kc^2\rho_0^2 V_0^2.$$

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

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

with the immediate following of

$$\varepsilon = mc^2, \qquad \hbar = \varepsilon/\omega = \frac{4\pi^2}{3} c\rho_0^2 V_0^2, \qquad p = mc = \frac{4\pi^2}{3} kc\rho_0^2 V_0^2 = \hbar k,$$

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

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

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.

Let's notice, that more complex, multi-curled elementary particles correspond to high-frequency perturbation waves with bigger mass and energy. It's natural to imply that the simplest half-curled particles with the spin of ½ when n = 1 are pairs "electron-positron". That way, electron is a double period cycle 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 [2], particle with topology of Moebius band meets the Pauli principle. But in the Feigenbaum-Sharkovskii-Magnitskii universal theory of dynamical chaos (FSM theory) [3-8 and other], results of which valid for every nonlinear differential equation system of macrocosm, the solution's difficulty increase starts from double period bifurcation of the initial singular cycle. Interesting enough, the newborn cycle of doubled period belongs to the Moebius band around the initial cycle! In another words, according to the FSM theory electron is an initial and simplest double period bifurcation from the infinite bifurcation cascade. Therefore, FSM theory works not only in macro-, but also in microcosm, and elementary particles defined by formulas (2.2), (2.4)-(2.5) are hardly the only elementary particles, which can emerge as the result of bifurcations in nonlinear equation system (2.1). Furthermore, more complex nonperiodic solutions of system (2.1) 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 particles are essentially futile.

3. 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 (2.1) when r is large in the following form:

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

Equation system (2.1) will take a form of

$$\frac{\partial \rho}{\partial t} + \frac{1}{r^2} \frac{\partial (r^2 \rho V)}{\partial r} = 0, \qquad (2.11)$$

$$\frac{\partial (\rho V)}{\partial t} + V \frac{\partial (\rho V)}{\partial r} = 0, \qquad (2.12)$$

meaning that of all four fields in the initial system (2.1) only gravitational field $G = V \frac{\partial (\rho V)}{\partial r}$ 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 can be neglected, and that agrees with experimental data.

Let's seek the solution of equation system (2.11)-(2.12) in form of $V = c/r^2$, that is in form of a wave, which propagates to the center of elementary particle with velocity dependant on radius. With the use of function V in equation system (2.11)-(2.12) and in case of $r \to \infty$ next expression will be derived

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

This formula defines gravitational (radial) wave propagating to the center of elementary particle ($r = 0$) with velocity $V = c/r^2$. 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 such thing as 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.

4. Summary

Let's draw several fundamental conclusions from theoretical analysis of the research and its results:

- all fields and material objects in the Universe are various perturbations of physical vacuum;

- the great Nicola Tesla was right all along, when affirmed that energy threads through all the space [9], while all of his opponents from the beginning of the XX century, who defied conception of physical vacuum (ether) for the two fancy, but unsound theories, were mistaken;

- microcosm and macrocosm are organized by the same laws – laws of classical mechanics, described by nonlinear differential equation systems 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;

- the existence of gravitation inseparably linked with the creation of elementary particles in form of curls of a single gravi-electromagnetic field, and such curls are created by perturbations of physical vacuum in places of creation of elementary particles;

- the attracting force is actually a pressure force in physical vacuum created by gravitational wave, which propagates to the center of the particle with velocity dependant on the distance between the particle and current position of the wave;

- the existence of a single gravi-electromagnetic field reveals brand new possibilities for such things as extraction of infinite amounts of energy out of

physical vacuum, control of gravitational fields, annihilation and synthesis of materials.

References

1. Kyriakos A.G. Theory of the nonlinear quantized electromagnetic waves, adequate of standard model theory. – Sp.B. BODlib, 2006, p 208.

2. Feyman P.R., Weinberg S. Elementary Particles and the Laws of Physics: the 1986 Dirac Memorial lectures. – Cambridge University Press, 1987.

3. Magnitskii N.A. Universal theory of dynamical chaos in dissipative systems of differential equations. - Comm. Nonlin. Science & Numer. Simul.,- ELSEVIER, 2008, 13, p.416-433.

4. Magnitskii N.A., Sidorov S.V. New Methods for Chaotic Dynamics (monograph), World Scientific, 2006, 380p.

5. Magnitskii N.A. New approach to the analysis of Hamiltonian and conservative systems.// Differential Equations. V.44, No12, pp 1682-1690, 2008.

6. Magnitskii N.A. On the nature of dynamic chaos in a neighborhood of a conservative systems.// Differential Equations. V45, No 5, pp 662-669, 2009.

7. Evstigneev N.M., Magnitskii N.A. On possible scenarios of the transition to turbulence in Rayleigh-Benard convection. // Doklady Mathematics, Vol.82, No1 pp 659-662, 2010.

8. Magnitskii N.A. Unified nonlinear bifurcation theory of field and matter. – Report, LLC "New Inflow", 2009. (in Russian)

9. Nikola Tesla. Lectures, patents, articles. – Tesla Book co.,1992.