Theoretical Basis and Proofs of the Existence of Atom Background Radiation

G. P. Shpenkov Institute of Mathematics & Physics, UTA, Kaliskiego 7, 85-796 Bydgoszcz, Poland shpenkov@janmax.com

Abstract

The first review devoted to an important discovery originated from the Dynamic Model of Elementary Particles (DM) is presented. Three different phenomena, found in the past century: ("relict") cosmic microwave background, the Lamb shift, and the anomalous magnetic moment of an electron, being considered in the framework of the DM (beyond quantum electrodynamics), proven to be connected with the spectrum of atom background radiation discovered on the basis of the DM as well. It is convincingly shown here. The indicated facts reveal the unknown earlier regularity in nature, namely the generality and the wave origin of three above phenomena. The results presented were obtained comparatively simply and in a logically non-contradictory way without use of the notion of virtual particles invented earlier to explain the Lamb shift and the anomalous magnetic moment. They thus call in question the correctness of an introduction in physics of the above notion.

1. Introduction

Any electronic system, independently of its complexity, has the definite minimal ("zero") level of background electronic noise, the threshold value of which cannot be eliminated of principle. The letter is defined by natural processes. It concerns both macro- and microelectronic systems, including the simplest ones, such as the hydrogen atom, contained one electron orbiting a proton. Actually, in Nature, all is in incessant motion, at all levels, that is the unquestioned feature of the surrounding world. The electron's motion in the hydrogen atom is affected first of all to specific constant internal influences (disturbances) depending on the dynamic features of intra-atomic wave fields, proton-electron exchange (interaction) and the character of electron's orbiting on the background of oscillating (and, hence, the dynamic as well) center of masses of proton-electron system.

The natural background inherent thus, as we assume, in the simplest electronic system, which is the hydrogen atom, must have the corresponding characteristic (background) spectrum of radiation and absorption. However, in spite of clearness and logical consistency of the above assumption, the problem of background atomic spectra, unfortunately, has never been raised before. Such a spectrum has never been studied, because nobody could even presume its existence. As a result, the phenomenon of background radiation and absorption of atoms was unknown till now.

Such omission happened because of the domination in physics the quantum mechanical (QM) concepts on the structure of atoms, fully formed in consciousness of physicists and unquestioned hitherto. The QM concepts originate from the Bohr Theory and kept its essential features. In accordance to one of them, an *atom does not emit energy being in equilibrium*. But as follows from the stated above, we have reasons to doubt whether this is true. QM nothing says how an electron moves in an atom, because the notion of a trajectory of an electron motion does not exist in QM of principle. QM accepted probabilistic concept recognizing only the probability of electron's location in every point of space around a nucleus in a definite time. The probabilistic interpretation excludes the existence of one-dimensional closed orbits (trajectories) of electron's motion.

Thus, an electron in the hydrogen atom must experience constant disturbances of the specific character during orbiting. Actually, the latter (as a slight energetic "shift", or "splitting" of spectral lines) was experimentally found first by W. Houston, in 1937 [1], and then measured with high precision in 1947 by W. Lamb and R. Retherford [2]. At that time existed theories of the atomic structure were unable to explain this phenomenon. The Bohr's postulates took so deep root in consciousness of physicists that no one could imagine that the explanation of the phenomenon one needs to seek in the specific dynamic structure of atoms. This circumstance along with the unknown nature of "anomalous" magnetic moment of electrons, found at that time as well, led physicists to the invention of the concept of *virtual particles* to describe both phenomena. As a result, on the basis of this concept, the development of a new theory, called quantum electrodynamics (QED), has begun.

According to (QED), the shift is a result of the interaction between an orbiting electron and the teeming virtual particles residing in the surrounding vacuum. Due to fluctuations of the zero field of vacuum, the orbital motion of the electron in an atom is affected to the additional chaotic motion. In course of time physicists fully developed the QED approach and resting on it they assume finally that the main constituents of energy "splitting", called the Lamb shift, are the effects of vacuum polarization, electron mass renormalization and *anomalous magnetic moment*. As concerns the latter property, let us recall the current definitions and status in this matter, which are necessary for further consideration.

The magnetic moment of an electron is defined in modern physics by the equality

$$\mu_e = g_e \frac{1}{2} \mu_B = (1 + a_e) \mu_B , \qquad (1.1)$$

where g_e is the electron g factor,

$$\mu_B = \frac{e\hbar}{2m_e c} \tag{1.2}$$

is the Bohr magneton, and

$$a_e = \frac{g_e - 2}{2} \tag{1.3}$$

is called the magnetic moment anomaly of the electron. The latter shows the exceeding of the expected value in one Bohr magneton, following from semi-classical field theories where g = 2, over the observed value of the magnetic moment of the electron known now experimentally to 12 significant figures [3],

$$g_e = 2.0023193043768(86). \tag{1.4}$$

The value ± 86 in (1.4) is the remaining uncertainty. Thus, because the Bohr magneton (defined from (1.2)) is equal in absolute value to

$$\mu_B = 927.400947(80) \cdot 10^{-26} J \cdot T^{-1}, \qquad (1.5)$$

the magnetic moment of the electron is

$$\mu_e = -928.476410(80) \cdot 10^{-26} J \cdot T^{-1}.$$
(1.6)

The precise value of g is derived in the framework of quantum electrodynamics (QED) with taking into account small terms having relation to quantum chromodynamics (QCD). Therefore, it is assumed that the experimental determination of the magnetic moment of the electron, bound in the hydrogen (and hydrogen like) atoms, like the determination of the Lamb shift, provides one of the most sensitive tests of QED.

The best theoretical value of a_e by QED, including small electroweak and Hadronic terms, [4] is

$$a_{e}(th) = 1.1596521535(12) \cdot 10^{-3} \tag{1.7}$$

The derivation of α_e with such a high precision is regarded in physics as one of the advantages of QED, because other ways of the derivation were not found till now.

It makes sense to show here the current theoretical value of $a_e(th)$ in the concise form, derived now [5] up to the forth order in the fine-structure constant α :

$$a_{e}(th) = 0.5 \left(\frac{\alpha}{\pi}\right) - 0.328478965579... \left(\frac{\alpha}{\pi}\right)^{2} + 1.181241456... \left(\frac{\alpha}{\pi}\right)^{3} - 1.5098(384) \left(\frac{\alpha}{\pi}\right)^{4} + 4.382(19) \cdot 10^{-12}.$$
(1.8)

Unfortunately till now, QED apart, other departments of physics, in the framework of existed theories of atoms and elementary particles, were unable to explain the Lamb shift just like they were unable to explain the electron's anomalous magnetic moment.

The Standard Model of Elementary Particles (SM), accepted in modern physics, attempts to explaining their behavior, *i.e.*, it focuses to answering the question "How". However, this model encounters difficulties when the question "Why" (or "What") arises. One of the fundamental mysteries, undisclosed in the framework of the SM, is "What is the nature of mass and charge of elementary particles?" It is no wonder, therefore, that the SM is unable to explain and describe the Lamb shift and anomalous magnetic moment of an electron as well. As an erroneous model, it cannot made it of principle.

Nevertheless, unknowing the primordial features of matter (the nature of mass and charge), physicists created, apart from an abstract model of "elementary" particles (SM), quantum mechanical (also abstract) model of atoms and continue to create models of a similar type (like string or superstring, *etc.*), including models of more complicated systems, such as the whole Universe [6].

In the course of time, many begin realize that some widely accepted basic concepts in physics are doubtful and they note: "...The ideas that were put in place by our intellectual ancestors in the early 1900's are insufficient to deal with the deep issues that are now being explored. The neat and tidy view of the 1970's has given way to confusing collections of paradoxes, puzzles, enigmas, and contradictions... [7]". It concerns, mostly, the problems of elementary particles, gravity and relativity.

It is widely recognized also that the SM "will not be the final theory" and "any efforts should be undertaken to finds hints for new physics" [8]. Understanding that our ideas concerning the fundamentals of physics are poor, overwhelming majority, unknowing other

ways, continues researches in a traditional way, creating more and more complicated abstract theories based on sophisticated mathematics.

This is why, the precise derivation of both the anomalous magnetic moment of an electron and the Lamb shift, carried out by QED, is regarded by the majority as the most stringent test of the validity of the QED theory dominated currently in physics.

Despite of the first and subsequent relatively fortunate calculations made with QED, which was initially developed to explain the Lamb shift in the hydrogen atom and the anomalous magnetic moment of an electron, "It is...far from clear that everything is okay with QED" [9]. Note in this connection, supporting the above view, that the expanded form of (1.7) is extremely complicated. Actually, the coefficient 1.5098(384) of the α^4 term (calculated with big uncertainty, ±384) consists of more than one hundred huge 10-dimensional integrals. Therefore, because of the complicated mathematical structure of coefficients of the α^n terms, a special system of massively-parallel computers was developed for the calculation of (1.7). In fact, we deal here with the masterly mathematical fitting (adjusting), which reached in the course of more than 55 years, passed after the work by H. A. Bethe [10] and T. A. Welton [11], of the highest extent of perfection due to the hard efforts of many skilled theorists over the World.

Sharing the aforementioned opinion, expressed by Berkeland *et al.* [9], we assume that not all possible elementary wave processes were taken into account to explain the aforementioned phenomena in another logically noncontradictory way. In particular, the specific wave processes running *inside* atoms and constituent particles (nucleons and electrons), and between these particles coupled in atoms, were not yet properly examined.

In the first works in this direction published quite recently [12, 13], the unknown earlier wave behavior of elementary particles and intra-atomic wave processes were taken into account. As a result, the chosen approach, which is in the base of the *Dynamic Model of Elementary Particles* (DM) [12], has obtained the further development. On the basis of the DM, the unknown earlier nature of some fundamental physical quantities and constants was revealed. First of all, it concerns the origin of mass and charge of elementary particles. Thus, we have arrived at last at the first explicit concepts on the origin of matter (mass) and the nature of the charge.

Many other interesting results, apart from aforementioned, were obtained after understanding the crucial role of the specific wave structure and wave behavior of elementary particles in the framework of the new model of elementary particles, the DM.

We regard atoms and "elementary" particles as the structures of the definite levels of the multilevel Universe. Therefore, it is clear; we should not consider atoms and elementary particles separately from the general structure of the Universe. It means that a *consideration* of the problem of structure of any material objects one should begin from the precise definition of the principal axioms on the structure of the Universe on the whole.

As originates from the one of the axioms of the general structure of the Universe [14, pp. 568-573], mutual transformations of fields with opposite properties (*e.g.*, the potential field \Leftrightarrow the kinetic field) cause the wave nature of the world. The wave process, appearing at some level, generates waves going deep into an infinite series of embedded field-spaces and induces wave processes at the higher lying levels.

Basing on these and other relevant axioms, the wave equation, describing the field of matter-space-time, has been solved. As a result, we found the kinematic spatial geometry of wave processes, including those occurring at the atomic and subatomic levels. In particular, these solutions revealed the nature of quasiperiodicity of elementary atomic structures and symmetry (including "forbidden to ordinary crystals" [15]).

According to the obtained solutions, atoms (and nucleons) have the quasispherical structure of characteristic shells with potential and kinetic nodal points-extremes of the

probabilistic potential. The main structural units of the atoms are *H*-atoms located (maximum by two) in principal potential polar-azimuth nodes-extremes. The known physical properties and phenomena, which have been already considered [14], are accounted for by this atomic model, which can be called the *multinuclear atomic model* [16]. It predicted and yielded the structure and mass of all possible isotopes [17]. In essence, it reveals the "genetic code" of the structural variety in nature.

The nodal shell structure of atoms and nucleons allows also the understanding of the physics of atomic reactions caused by an inelastic interaction of high-energy particles with substance. Calculated binding energies of filled up nodes and shells and the elementary proper energy of *H*-atoms (to which we relate protons, neutrons and hydrogen atoms) in the nodes are in conformity with the experimental data of nuclear physics.

In the framework of the presented approach, resting on the results obtained, the unified description of fundamental interactions (electromagnetic, gravitational, and nuclear) became possible as well [14].

The DM gives the first opportunity to explain the Lamb shift and anomalous magnetic moment of an electron from a new point of view by fully developed methods of wave physics, beyond QED. According to the DM, a center of mass of a proton and its so-called wave shell are affected by proper wave influence (owing to the wave structure and behavior of the proton according to the definition). Therefore, they constantly oscillate with the definite frequency and amplitude; in the state of equilibrium as well. Disturbing the electron's orbiting on the fundamental frequency of wave exchange, different from the frequency of orbiting, they cause natural background oscillations of an electron in the hydrogen atom on this frequency. This process was examined theoretically and proved to be valid, being in conformity with evidences that are described first in [18].

Thus, the natural (unceasing) intra-atomic oscillations influence the orbiting electron and form the spectrum of zero level (background) radiation. The background radiation spectral formula for the hydrogen atom was obtained in the work [18] on the basis of radial solutions to the wave equation in spherical (for the proton) and cylindrical (for the orbiting electron) coordinates. The only spectral line of the background spectrum, corresponding to the 2.7 K temperature, was calculated and presented there.

Continuing this work, the first ten (major) spectral terms of the background spectrum were computed further [13]. The computation was carried out on the basis of the formula of the background spectrum, which was refined as compare with that one first presented in [18]. In all cases, we used the current "CODATA recommended values" for fundamental physical constants. An analysis of the spectrum obtained has showed that the energetic difference between the nearest terms corresponds in value to the 1S and 2S Lamb shifts. It indicates at the natural bond of the Lamb shift with the background spectrum, revealing thus the nature of the "shift" and additionally confirming the correctness of the derived spectrum.

The data thus shows that cosmic microwave background radiation (CMB) of the top temperature of 2.7 K and the Lamb shift both have the same source of their origination; both phenomena reflect the unit process. They reveal the different elementary parameters of the background spectrum of the hydrogen atom: energetic structure (wavelengths and frequencies) of spectral terms of the background radiation of hydrogen (detected in Cosmos just because of the immense abundance of hydrogen there) and the frequency (energetic) gaps between these terms (detected at the atomic level as the Lamb shifts).

The results obtained thus call in questions the Big Bang hypothesis of the CMB origin, regarded until now by the majority as a "relict" background radiation left after the Big Bang. They cast doubt as well upon the QED concept of "virtual" particles invented and introduced first just for the explanation of Lamb shifts and the anomalous magnetic moment of an electron.

For understanding the matter in question, we recall concisely in the next section o few of the principal notions which belong to the realm of the DM [12]. Further, we will show the main steps, which lead to the unknown earlier generalized spectral formula for the hydrogen atom [18]. Note that the spectral terms in this formula are expressed for the first time by roots of Bessel functions, *i.e.*, by the direct radial solutions. Then, on the basis of the above considered notions and obtained results, we will proceed to the derivation of background spectrum of the hydrogen atom [13]. The true nature (origin) of the Lamb shifts, unknown earlier, will be clear apparent from the calculated terms, as the differences between these terms. And finally, we will proceed to the derivation of the great possibilities of the DM. All these facts thus confirm that the Dynamic Model more correctly reflects reality (in particular, the structure of microparticles) in comparison with the Standard Model of Elementary Particles (SM). They additionally justify in favor of the correctness of the background spectrum derived and presented here.

2. The Dynamic Model of Elementary Particles

a) Main definitions.

Let us imagine an elementary particle as a dynamic spherical formation of a complicated structure being in a dynamic equilibrium with environment through the wave process of the definite frequency ω . Longitudinal oscillations of its wave shell in the radial direction provide an interaction of the particle with other objects and the ambient field of matter-space-time (Fig. 2.1).

We assume that a spherical wave shell bounds the space of an elementary particle, separating it from the ambient wave field. We call this sphere the *characteristic sphere* of a microparticle. The characteristic sphere restricts the *main part of the microparticle* from its *field part* merging gradually with the ambient field of matter-space-time.



Fig. 2.1. An element of the volume (*a*) of the wave shell in a spherical field of exchange: a particle – ambient field of matter-space-time; $\hat{p}dS$ and $(\hat{p} + \frac{\partial \hat{p}}{\partial r}dr)dS$ are powers of exchange of the field with the element of shell, *dS*, of the particle; \hat{p} is the two-dimensional density of exchange, or the pressure of the field of exchange. The internal and external parts of an elementary particle (*b*).

The *main part* (core) is the *basis* of a microparticle, whereas the *field part* represents its *superstructure*. Thus, the *basis space* of a microparticle is restricted by the *characteristic sphere*, beyond which there is the space of its *superstructure*. Such a model interprets a microparticle as a particular discrete physical point of an arbitrary level of matter-space-time, restricted by the characteristic sphere and being in rest in the field-space.

The velocity of wave exchange (interaction) is presented in the form

$$\hat{\upsilon} = \upsilon(kr)e^{i\omega t}, \qquad (2.1)$$

where

$$k = \frac{2\pi}{\lambda} = \frac{\omega}{c} \tag{2.2}$$

is the wave number corresponding to the definite fundamental frequency of the field of exchange ω , characteristic to the subatomic level of the Universe.

The volumetric rate of mass exchange of the particles with environment called the *exchange charge*, or merely the charge, is defined as

$$\hat{Q} = \frac{d\hat{m}}{dt} = S\hat{\upsilon}\varepsilon, \qquad (2.3)$$

where S is the area of a closed surface separating the space of an elementary particles from the surrounding field of matter-space-time, \hat{v} is the speed of wave exchange (interaction) at the separating surface. The mass \hat{m} is a resulting mass of wave exchange: a particle – environment. It is an *associated field mass* of the particle.

Strictly speaking, the *exchange charge is the measure of the rate of exchange of matterspace-time*, or briefly the *power of mass exchange*. In this wider sense, the area of exchange *S* does not necessary concern the closed surface. The symbol "^" expresses the contradictory (or complex) potential-kinetic character of physical space-fields [20].

A ratio of mass dm and volume dV of elementary particles defines their *absolute-relative* density ε :

$$\varepsilon = \frac{dm}{dV} = \varepsilon_0 \varepsilon_r \,, \tag{2.4}$$

where

$$\varepsilon_0 = 1 \ g \cdot cm^{-3} \tag{2.5}$$

is the *absolute unit density* and ε_r is the *relative density*.

In a case of a microobject of the spherical structure, the measure of exchange charge (2.3) is

$$\hat{Q} = 4\pi a^2 \hat{\upsilon} \varepsilon_0 \varepsilon_r, \qquad (2.6)$$

where *a* is the radius of the wave shell of the microobject.

In this model, according to the definition [12], the inner geometrical space (spherical volume) of an elementary particle, restricted by its wave spherical shell, is the external world of the particle. As the external world of the Universe (Fig. 2.1b), this space (inside the spherical volume) naturally can be called the Antiuniverse. In this sense, the World (Being and Nonbeing) is presented here through the Universe and Antiuniverse. Obviously, the spaces of the Universe and Antiuniverse are closed on each other. Most probably, the main essence of life, its mystery, is hidden in the Antiuniverse.

The hydrogen atom is a simplest paired centrally symmetric proton-electron system. According to the DM, the hydrogen atom is also a pure *wave* dynamic formation. It means

that a proton, just like an electron or any elementary particle, is in a state of continuous dynamic exchange (equilibrium) with environment through the wave process of the definite unchanged frequency ω (recalling a micropulsar). From the above definition it follows that elementary particles of the Dynamic Model, being unceasingly pulsing microobjects, can be regarded as unexhaustible sources of the so-called zero point energy.

A pulsing spherical wave shell of a proton (and of an electron) separates its inner space from ambient wave fields. The shell restricts the main part (core) of the particle from its field part merging gradually with the ambient field of matter-space-time.

Longitudinal oscillations of the spherical wave shell of the proton provide an interaction in radial direction (more correctly exchange of matter-space and motion-rest [12]) with the surrounding field-space and with the orbiting electron. The orbital motion of the electron is associated with the transversal cylindrical wave field. Therefore, the common three-dimensional wave equation is valid for both cases. Both dynamic constituents of the proton-electron system have to be described, respectively, by spherical and cylindrical wave functions.

The existence and interactions of the particles are in essence, following the DM, a continuous process of wave *exchange* of matter-space-time. The wider (and, hence, truer) notion *exchange* is thus more correct than the notion *interaction* because it reflects both behavior of elementary particles in their dynamic equilibrium with the ambient field, at rest and motion, and interactions with other objects (and particles themselves). In other words, the notion *exchange* is more appropriate from the point of view of the physics of the complex behavior of elementary particles viewed as dynamic micro-objects belonging to one of the interrelated levels of the many-level Universe.

b) The nature of mass and charge.

An equation of exchange of matter-space-time for an elementary volume drdS of a characteristic spherical shell, according to the model shown in Fig. 2.1, where dS and dr are the area and thickness of the volume, is

$$\varepsilon_0 \varepsilon_r dr dS \frac{dS}{dt} = -\frac{\partial p}{\partial r} dr dS$$

or

$$\frac{d\hat{\mathbf{0}}}{dt} = -\frac{1}{\varepsilon_0 \varepsilon_r} \frac{\partial \hat{p}}{\partial r}.$$
(2.7)

A wave of the density of exchange \hat{p} has, in a spherical field, the form

$$\hat{p} = \frac{p_m}{kr} e^{i(\omega t - kr)}, \qquad (2.8)$$

where p_m is the amplitude of the density of exchange at the boundary of the wave zone defined by the condition kr = 1.

We are interested in the derivation of the rate of exchange, *i. e.*, in the expanded explicit form of the product of \hat{p} and S,

$$\hat{p}S = F_s, \qquad (2.9)$$

which has the dimensionality of the rate of exchange of momentum, as the expressions $\hat{m}\frac{d\hat{v}}{dt}$

and $\hat{\upsilon}\frac{d\hat{m}}{dt}$. This equality must lead us first of all to analytic expressions for the mass *m*, as the *measure of exchange*, and to its derivative dm/dt, as the measure of the *rate of mass exchange* (2.3). We will call \hat{F}_s also the *power of exchange*. With this, we should not identify the power

of exchange of momentum \hat{F}_s with the scalar power N of exchange of energy W: N=dW/dt. Both N and \hat{F}_s are powers of exchange expressed by the concrete measures of exchange. We do not use the notion "force", because it is incorrect to relate our sensations of exchange to something unreal or fictitious under this notion.

After some transformations, with use of (2.1), (2.7), and (2.8), we arrive at the following equation of powers of exchange of the spherical particle with the ambient field of matter-space-time:

$$\hat{p}S = \hat{F}_s = \frac{4\pi r^3 \varepsilon_0 \varepsilon_r}{1 + k^2 r^2} (1 - ikr)\hat{\upsilon}i\omega.$$
(2.9a)

This equation contains information about both the exchange of motion and exchange of mass. Therefore, we can present Eq. (2.9a) in two forms. The first one is as follows.

Because

we have

$$\frac{d\hat{\mathbf{v}}}{dt} = i\omega\hat{\mathbf{v}},\qquad(2.10)$$

$$\frac{4\pi r^3 \varepsilon_0 \varepsilon_r}{1+k^2 r^2} \frac{d\hat{\upsilon}}{dt} + \frac{4\pi r^3 \varepsilon_0 \varepsilon_r}{1+k^2 r^2} k r \omega \hat{\upsilon} = \hat{F}_s.$$
(2.11)

The equation of powers of exchange (2.11) represents in form the classical equation (Newton's second law) describing the motion in the field-space with the resistance R, namely

$$m\frac{d\hat{\upsilon}}{dt} + R\hat{\upsilon} = \hat{F}, \qquad (2.12)$$

where

$$m = \frac{4\pi r^3 \varepsilon_0 \varepsilon_r}{1 + k^2 r^2} \tag{2.13}$$

is the effective mass of a particle, it is the field mass in the central exchange. We call it the *associated mass of the particle* (analogous with the *added mass* in hydrodynamics associated with vibration of an object in water, for example, a pulsing sphere). The second term in (2.12) contains the coefficient *R* that is the coefficient of resistance or the dispersion of rest-motion at exchange: it is equal to

$$R = \frac{4\pi r^3 \varepsilon_0 \varepsilon_r}{1 + k^2 r^2} kr\omega. \qquad (2.14)$$

Obviously, masses of all dynamic formations (micro-particles) in the Universe, according to the DM, have *associated field character* with respect to the deeper level of the field of matter-space-time; therefore, their own (proper, rest) masses do not exist.

Associated potential mass, or merely the associated mass of the particle, or briefly the mass of the particle is defined by the formula (2.13), where *r* is the radius of the spherical wave shell (Fig. 2.1); $\varepsilon_0 = 1g \cdot cm^{-3}$ is the absolute unit density (2.5) and ε_r is the relative density; $k = 2\pi/\lambda = \omega/c$ is the wave number (2.2) corresponding to the fundamental frequencies ω_e of the field of exchange (which are characteristic of the subatomic level of the Universe). The detail derivation of the formula (2.13) one can find in [12] accessible on-line in Internet in PDF format.

The Equation (2.12) describes the exchange of motion, but the mass exchange, according to the definition, is defined by exchange charges \hat{Q} (2.3). In this case, the equation of powers of exchange (2.9a) must be presented in the form contained the rate of mass exchange, exchange charge \hat{Q} , namely as

$$\frac{d\hat{m}}{dt}\hat{\upsilon} = \hat{Q}\hat{\upsilon} = \hat{F}_s.$$
(2.15)

In this connection, let us rewrite (2.9a) as

$$\left(\frac{4\pi a^3\varepsilon_0\varepsilon_r}{1+k^2a^2}i\omega + \frac{4\pi a^3\varepsilon_0\varepsilon_r}{1+k^2a^2}kr\omega\right)\hat{\upsilon} = \hat{F}_s.$$
(2.16)

Hence, we see that the charge of exchange \hat{Q} has the active-reactive character:

$$\hat{Q} = \frac{4\pi a^3 \varepsilon_0 \varepsilon_r}{1 + k^2 a^2} ka\omega + i \frac{4\pi a^3 \varepsilon_0 \varepsilon_r}{1 + k^2 a^2} \omega = Q_a + iQ_r, \qquad (2.17)$$

where

$$Q_a = \frac{4\pi a^3 \varepsilon_0 \varepsilon_r}{1 + k^2 a^2} ka\omega \qquad (2.18)$$

is the active charge, and

$$Q_r = \frac{Q_a}{ka} = m\omega = \frac{4\pi a^3 \varepsilon_0 \varepsilon_r}{1 + k^2 a^2} \omega$$
(2.19)

is the *reactive charge*.

The active component Q_a defines the dispersion during exchange, which in a steady-state process of exchange is compensated by the inflow of motion and matter from the deeper levels of space.

The reactive component of charge Q_r , called in contemporary physics the "*electric*" charge (further for brevity, the *charge of exchange Q*) is connected with the associated mass m (2.7) by the relation

$$Q = m\omega. \tag{2.20}$$

The *dimensionality* of the exchange charge is $g \cdot s^{-1}$.

The DM reveals thus the physical meaning of two of the fundamental notions of physics the notions of mass and electric charge. The exchange ("electric") charge is merely the measure of the *rate of exchange* of matter-space-time, or briefly the power of mass exchange; its alternate value changes with the fundamental frequency ω .

The exchange charge q is connected with the Coulomb charge q_c of the dimensionality $g^{\frac{1}{2}} \cdot cm^{\frac{3}{2}} \cdot s^{-1}$ (in the CGSE system, expressed by fractional powers at the units of mass and length [21]) by the formula

$$q = q_C \sqrt{4\pi\varepsilon_0} , \qquad (2.21)$$

where $\varepsilon_0 = 1g \cdot cm^{-3}$ is the *absolute unit density*. Hence, the *electron's exchange (reactive) charge* has the value

$$e = e_C \sqrt{4\pi\varepsilon_0} = 1.702691627 \cdot 10^{-9} \ g \cdot s^{-1}, \qquad (2.22)$$

since $e_C = 4.803204401 \cdot 10^{-10} CGSE_q$. The absolute value (2.22), the electron's charge, represents an *elementary quantum of the rate of mass exchange*.

The *fundamental frequency* of the wave field of exchange at the *subatomic level* (the frequency of "*electrostatic*" field), determined on the basis of the found relation (2.20), is

$$\omega_e = e / m_e = 1.869162505 \cdot 10^{18} \, s^{-1}, \qquad (2.23)$$

where $m_e = 9.109382531 \cdot 10^{-28} \ g$ is the electron mass.

The fundamental wave radius, corresponding to this frequency, is

$$\lambda_{\rho} = c/\omega_{\rho} = 1.603886538 \cdot 10^{-8} \, cm \,.$$
 (2.24)

The *fundamental wave diameter* $D = 2\lambda_e = 0.32nm$ correlates with the average value of lattice parameters in crystals, defining an average discreteness of space at the subatomic level of exchange (interaction).

The radius of the wave shell of the electron r_e (the electron radius, for brevity), derived from the formula of mass (2.13) under the condition $m = m_e$, $r = r_e$, $k_e = 1/\lambda_e$, $\varepsilon_r = 1$, $c = 2.99792458 \cdot 10^{10} \text{ cm} \cdot \text{s}^{-1}$, $\omega = \omega_e$ (2.23), and $\lambda = \lambda_e$ (2.24), is

$$r_e = 4.17052597 \cdot 10^{-10} \, cm \,. \tag{2.25}$$

In conclusion to this section, we should stress the following important peculiarity of the DM. We regard the physical field-space of the Universe as an infinite series of spaces embedded in each other (recalling a set of nesting dolls, or infinite functional series $f(x) = \sum_{k=1}^{\infty} u_k(x)$). This series of spaces expresses the fundamental concept of natural philosophy concerning the infinite divisibility of matter. Every level of space is the basis level for the nearest above-situated level and, simultaneously, it is the level of superstructure for the nearest below-situated level. This means that above-situated field-spaces are formed on the basis of below-lying field-spaces. Accordingly, there is no meaning to the concept of "very last elementary particle" in the common classical sense of this phrase [14], *etc*.

We will use further the above presented fundamental constants (e, ω_e, λ_e , and r_e) for the derivation of the background spectrum of the hydrogen atom and for the precise derivation of the magnetic moment of an electron.

3. A Generalized Spectral Formula for the Hydrogen Atom

Thus, the hydrogen atom, as a paired wave centrally symmetric proton-electron system, is in a continuous dynamic equilibrium with environment through the wave process of the definite frequency ω . The three-dimensional wave equation, for the description of longitudinal oscillations of pulsing spherical wave shell of the proton and the description of transversal cylindrical wave field of the orbiting electron, has the form

$$\Delta \hat{\Psi} - \frac{1}{c^2} \frac{\partial^2 \hat{\Psi}}{\partial t^2} = 0.$$
(3.1)

Spherical and cylindrical wave functions satisfying to Equation (3.1) are presented, respectively, as

$$\hat{\Psi} = \hat{R}_l(kr)\Theta_{l,m}(\theta)\hat{\Phi}_m(\phi)\hat{T}(\omega t), \qquad (3.2)$$

$$\hat{\Psi} = \hat{R}_m(k_r r) \hat{Z}(k_z z) \hat{\Phi}_m(\varphi) \hat{T}(\omega t).$$
(3.3)

The longitudinal and transversal components of the spherical-cylindrical field are described over spherical and cylindrical realizations of the wave equation (3.1), which comes in both cases (corresponding to the spatial coordinates r, θ , φ and r, z, φ) to one time equation and three spatial equations.

According to the solutions of (3.1), electron transitions in atoms depend on the structure of their radial shells, *i. e.*, on radial solutions (functions). Radial spherical and cylindrical functions $\hat{R}_l(kr)$ and $\hat{R}_m(k_r r)$, respectively, entered in (3.2) and (3.3), are uniquely determined by the general structure of the following radial equations:

$$\rho^{2} \frac{d^{2} \hat{R}_{l}}{d\rho^{2}} + 2\rho \frac{d\hat{R}_{l}}{d\rho} + (\rho^{2} - l(l+1)\hat{R}_{l} = 0, \qquad (3.4)$$

$$\frac{d^2\hat{R}}{d(k_r r)^2} + \frac{1}{k_r r} \frac{d\hat{R}}{d(k_r r)} + \left(1 - \frac{m^2}{(k_r r)}\right)\hat{R} = 0, \qquad (3.5)$$

where $\rho = kr$.

In the *central spherical wave field* of the hydrogen atom, amplitude of radial oscillations of the spherical shell of the proton [14], originated from solutions of (3.4), is

$$A_{sph} = \frac{A\hat{e}_l(kr)}{kr},$$
(3.6)

where

$$\hat{e}_{l}(kr) = \sqrt{\frac{\pi kr}{2}} (J_{l+\frac{1}{2}}(kr) \pm iY_{l+\frac{1}{2}}(kr)), \qquad (3.7)$$

$$k = \omega / c \,. \tag{3.8}$$

Here J(kr) and Y(kr) are Bessel functions; ω is the oscillation frequency of pulsating spherical shell of the proton equal to the fundamental "carrier" frequency of the subatomic and atomic levels [12, 14]. Zeros and extrema of the Bessel cylindrical functions, $J_{l+\frac{1}{2}}(kr)$ and $N_{l+\frac{1}{2}}(kr)$ (or $Y_{l+\frac{1}{2}}(kr)$), are designated, correspondingly, as $j_{(l+\frac{1}{2}),s}$, $y_{(l+\frac{1}{2}),s}$, $j'_{(l+\frac{1}{2}),s}$, and $y'_{(l+\frac{1}{2}),s}$. Analogously, zeros and extrema of the Bessel spherical functions are designated as $a_{l,s} = j_{(l+\frac{1}{2}),s}$, $b_{l,s} = y_{(l+\frac{1}{2}),s}$, $a'_{l,s}$, and $b'_{l,s}$ [22].

The amplitude energy of the pulsing shell takes the following form

$$E_{sph} = \frac{m_0 \omega^2 A_{sph}^2}{2} = \frac{m_0 \omega^2}{2} \left(\frac{A}{kr}\right)^2 \left|\hat{e}_l(kr)\right|^2 = \frac{m_0 c^2 A^2}{2r^2} \left|\hat{e}_l(kr)\right|^2, \quad (3.9)$$

where m_0 is the proton mass, A is the constant equal to the oscillation amplitude at the sphere of the wave radius (kr=1). Let $kr_0 = z_{l,1}$ and $kr_s = z_{l,s}$, where $z_{l,s}$ and $z_{l,1}$ are zeros of Bessel functions $J_{l+\frac{1}{2}}(kr)$, the following relation between radial shells is valid:

$$r_s = r_0 \left(\frac{z_{l,s}}{z_{l,1}}\right).$$
 (3.10)

The subscript l indicates the order of Bessel functions and s, the number of the root. The last defines the number of the radial shell. Zeros of Bessel functions define the radial shells with zero values of radial displacements (oscillations), *i.e.*, the shells of stationary states.

In the *cylindrical wave field*, the energy E_{cyl} , as the sum of energies of two mutuallyperpendicular potential-kinetic oscillations of the orbiting electron, is equal (in the simplest case) to

$$E_{cyl} = m_e \upsilon^2 = m_e \omega^2 A_{cyl}^2 = m_e \omega^2 \left(\frac{a}{\sqrt{kr}}\right)^2 = 2\pi m_e \upsilon A_{cyl} \upsilon, \qquad (3.11)$$

where m_e is the mass of an electron; r is the radius of its orbit; v is the frequency of its oscillations with the amplitude

$$A_{cyl} = \frac{a}{\sqrt{kr}}; \qquad (3.12)$$

and $\upsilon = \omega A_{cvl}$ is the amplitude velocity of the oscillations.

Because $k = \frac{\omega}{c}$, Equation (3.11) reduces to

$$E_{cyl} = hv, \qquad (3.13)$$

where $h = \frac{2\pi m_e ca^2}{r} = 2\pi m_e \upsilon A_{cyl}$ is an elementary action.

If $kr = \frac{\omega r_0}{c} = \frac{\upsilon_0}{c}$, where υ_0 is the Bohr velocity, then amplitude of oscillations A_{cyl} is equal to the Bohr radius r_0 : $A_{cyl} = \frac{a}{\sqrt{kr}} = r_0$. The constant *a*, equal to the oscillation amplitude at the

Bohr orbit r_0 , has thus the value

$$a = \sqrt{\frac{hr_0}{2\pi m_e c}} = 4.52050647 \cdot 10^{-10} \, cm \,, \tag{3.14}$$

where $h = 2\pi m_e \upsilon_0 r_0 = 6.6260693(11) \cdot 10^{-27} erg \cdot s$ is the Planck constant, $r_0 = 0.5291772108(18) \cdot 10^{-8} cm$, and $c = 2.99792458 \cdot 10^{10} cm \cdot s^{-1}$.

Since the steady equilibrium exchange (interaction) between spherical and cylindrical fields in the hydrogen atom takes place invariably, the equality

$$E_{cyl} = \Delta E_{sph} \tag{3.15}$$

is always valid. Hence, with allowance for (3.9) and (3.13), the following equation is valid

$$h\frac{c}{\lambda} = \frac{m_0 c^2 A^2}{2r_0^2} \left(\frac{\left| \hat{e}_p(kr_m) \right|^2 z_{p,1}^2}{z_{p,m}^2} - \frac{\left| \hat{e}_q(kr_n) \right|^2 z_{q,1}^2}{z_{q,n}^2} \right)$$
(3.16)

Thus, we have arrived at the spectral formula of the hydrogen atom, presented for the first time [12] in a expanded comprehensive form, *i.e.*, in the form where instead of quantum numbers *m* and *n* are roots of Bessel functions – right radial solutions. Therefore, we can regard the resulting presentation by the roots $z_{k,l}$ as a more correct mathematical presentation of the spectral formula.

At p=q=0, zeros of Bessel functions $J_{0+\frac{1}{2}}(z_{0,s})$ are equal to $z_{0,s} = s\pi$ [22] and

$$\left|\hat{e}_{0}(kr_{s})\right|^{2} = 1.$$
(3.17)

Under this condition, Eq. (3.16) is transformed into an elementary spectral formula for the hydrogen atom:

$$\frac{1}{\lambda} = R \left(\frac{1}{m^2} - \frac{1}{n^2} \right), \tag{3.18}$$

where m and n are integers, and

$$R = \frac{m_0 c A^2}{2h r_0^2}$$
(3.19)

is the Rydberg constant.

Because $R = \frac{R_{\infty}}{(1 + m_e/m_0)} = 109677.5833 \, cm^{-1}$, hence

$$A = r_0 \sqrt{\frac{2hR}{m_0 c}} = 9.00935784 \cdot 10^{-13} \ cm \,. \tag{3.20}$$

Assuming in the formula (3.6) that kr is equal to the first extremum of the spherical function of the zero order, unequal to zero,

$$kr = a'_{0,2} = 4.49340946, \qquad (3.21)$$

the first maximal amplitude of radial oscillations gets the value

$$\langle A_s \rangle = \left(\frac{1}{\sqrt{2}}\right) \frac{A}{kr} = 1.41776041 \cdot 10^{-13} \ cm \ .$$
 (3.22)

The center of masses of the proton, performing such oscillations, forms a *dynamic* spherical volume with the radius equal to the amplitude of the oscillations and its volume can be regarded as a nucleus.

4. Background Spectrum of the Hydrogen Atom and the Lamb Shift

According to the DM, exchange of energy between the proton and the orbiting electron in real conditions occurs, thus, on the background of oscillations of the center of mass of the proton and on the background of exchange with the surrounding field-spaces of a different nature. Hence, the equation of exchange (interaction) (3.15) should generally be presented as $E_{cyl} = \Delta E_{sph} + \delta E$, where δE takes into account various perturbations of the orbital electron motion.

The orbiting electron in hydrogen (both in equilibrium and exited states) *constantly* exchanges the energy with the proton at the fundamental frequency inherent in the subatomic

level ω_e (2.23) [12]. This exchange process between the electron and proton has the dynamically equilibrium character and runs on the background of the superimposed oscillatory field. The latter is characterized by a system of radial standing waves, which define "zero level exchange" [18] in a dynamically equilibrium state of the atom.

The frequency spectrum of zero wave perturbation is defined from the equation

$$\frac{1}{\lambda} = R \left(\frac{1}{n^2} - \frac{1}{\left(n + \delta n \right)^2} \right),\tag{4.1}$$

where $\delta n = \delta r / r_0$ is the relative measure of background perturbations δr of the orbital radius r_0 (the Bohr radius) at the level of zero exchange.

The δr value consists of two terms:

$$\delta r = \delta r_0 - \frac{r_e}{r_0} \delta r_e. \tag{4.2}$$

The first of them, δr_0 , takes into account background perturbations of the orbital motion of an electron regarded as a point-like particle.

According to the DM, an electron, like a proton or any elementary particle, is an expanded (spherical) dynamic formation of a certain radius r_e (2.25), which is approximately in ten times less than the Bohr radius r_0 . Oscillations of the center of mass of the electron itself, as a whole, with respect to the center of mass of the hydrogen atom, reduce the effective value of δr_0 . The second term in (4.2) $(r_e/r_0)\delta r_e$ with the minus sign takes into account this circumstance.

In the spherical wave field of the hydrogen atom, both quantities, δr_0 and δr_e , are determined, as follows from (3.6), by roots of Bessel functions and depend on the value of the constant *A*. The term δr_0 has the form

$$\delta r_0 = \frac{Ae_p(z_{p,s})}{z_{p,s}} = \frac{A}{z_{p,s}} \sqrt{\frac{\pi z_{p,s}}{2} \left(J_p^2(z_{p,s}) + Y_p^2(z_{p,s})\right)},$$
(4.3)

where the constant A is defined by (3.20). The term δr_e has the analogous form

$$\delta r_e = \frac{A_e e_m(z_{m,n})}{z_{m,n}} = \frac{A_e}{z_{m,n}} \sqrt{\frac{\pi z_{m,n}}{2} \left(J_m^2(z_{m,n}) + Y_m^2(z_{m,n}) \right)}, \qquad (4.4)$$

where the constant A_e differs from A (3.20) because it is defined as

$$A_e = r_e \sqrt{\frac{2Rh_e}{m_0 c}} . \tag{4.5}$$

In this formula, r_e is the theoretical radius of the wave shell of the electron (the electron radius for brevity) (2.25) determined in the DM from the formula of mass of elementary particles (2.13).

The quantity h_e entered in (4.5),

$$h_e = 2\pi m_e \upsilon_0 r_e = 5.222105849 \cdot 10^{-28} \, erg \cdot s \,, \tag{4.6}$$

is the orbital action of the electron (analogous to the Planck constant *h*) caused by its proper rotation around own center of mass with the speed v_0 . The rotation is realized during the electron orbiting around the proton with the same (Bohr) speed

$$\upsilon_0 = 2.187691263 \cdot 10^8 \ cm \cdot s^{-1}. \tag{4.7}$$

Substituting all quantities in (4.5), we obtain

$$A_e = 1.993326236 \cdot 10^{-14} \, cm \,. \tag{4.8}$$

The final condition concerns the choice of the numerical factor β_n multiplied by $\left(\frac{r_e}{r_0}\right)\delta r_e$ in the case of the roots $z_{p,s} = j'_{p,s}$. The matter is that roots $y_{p,z}$ represent equilibrium kinetic radial shells, whereas $j'_{p,s}$ represent extrema of potential shells [16] exhibited under the excitation of the hydrogen atom (note that $j'_{0,2} = j_{1,1}, j'_{0,3} = j_{1,2},...,$ where $j_{p,s}$ are zeros of potential shells). Hence, for the exited atom, the value δr will be slightly differing from the equilibrium value defined by (4.2).

We take into account the above circumstance, varying insignificantly the smallest (second) term in (4.2) by the empirical numerical factor β_n , so that the equality (4.2) takes the form:

$$\delta r = \delta r_0 - \beta_n \frac{r_e}{r_0} \delta r_e.$$
(4.9)

Thus, we have arrived at the following resulting formula for δn :

$$\delta n = \frac{\delta r}{r_0} = \sqrt{\frac{2Rh}{m_0 c}} \cdot \frac{e_p(z_{p,s})}{Z_{p,s}} - \beta_n \frac{r_e^2}{r_0^2} \sqrt{\frac{2Rh_e}{m_0 c}} \cdot \frac{e_m(z_{m,n})}{Z_{m,n}} \,. \tag{4.10}$$

The roots of Bessel functions and empirical values of β_n , taken for calculations by (4.10), are presented in Table I for the first two integer numbers, n = 1 and n = 2, entered in (4.1).

TABLE I. The roots of Bessel functions, $Z_{p,s}$ and $Z_{m,n}$, and the numerical factors β_n used for calculations by (4.1), n = 1, 2

S	$Z_{p,s}$ [22]	Z _{m,n} [22]	β_1 (<i>n</i> =1); β_2 (<i>n</i> =2)
1	$y_{0,1} = 0.89357697$	y' _{0,1} = 2.19714133	
2	$y_{0,2} = 3.95767842$	y' _{0,1} = 2.19714133	
	j' _{0,2} = 3.83170597	j' _{1/2,1} =1.16556119	$\beta_1 = 1.203068949$
			β ₂ =1.018671584
3	$y_{0,3} = 7.08605106$	y' _{0,1} = 2.19714133	
	j' _{0,3} = 7.01558667	j' _{1/2,1} =1.16556119	$\beta_1 = 1.203068949$
			β ₂ =1.018671584

On the basis of the formula (4.1), with allowance for (4.10) and the data of Table I, we estimate a few most probable perturbations of the stationary (n = 1) and exited (n = 2) states in the hydrogen atom for the case with p = m = 0 and s = 1, 2, and 3.

The results of calculations by the formula (4.1) under the above conditions are presented in Tables II - IV.

S	$Z_{\mathrm{p},s}$	Z _{m,n}	β_n	$1/\lambda, cm^{-1}$ (4.1)	λ, <i>cm</i>	Т, К	T _{exp} , K [23]
1	y _{0,1}	y'0,1		41.751724	0.023951	12.10805	
2	y 0,2	y'0,1		9.40602023	0.106315	2.72774	$\textbf{2.728} \pm \textbf{0.002}$
	j' 0,2	j'1/2,1	β_1	9.67863723	0.103320	2.80680	
3	y 0,3	y'0,1		5.240486	0.190822	1.51974	
	j' 0,3	j'1/2,1	β_1	5.255841	0.190265	1.52419	

TABLE II. The terms, $1/\lambda$, of background spectrum (4.1) of the hydrogen atom, n = 1

TABLE III. The terms, $1/\lambda$, of background spectrum (4.1) of the hydrogen atom, n = 2

S	$Z_{p,s}$	Z _{m,n}	β_n	$1/\lambda, cm^{-1}$ (4.1)	λ, <i>cm</i>	Т, К
1	y 0,1	y'0,1		5.219748	0.191580	1.5137
2	y 0,2	y'0,1		1.1758681	0.850436	0.3410
	j' 0,2	j'1/2,1	β_2	1.211154	0.825659	0.3512
3	y 0,3	y'0,1		0.6550701	1.526554	0.18997
	j' 0,3	j'1/2,1	β_2	0.6582849	1.519099	0.1909

TABLE IV. The frequency gaps, Δv , between the nearest background terms in the hydrogen atom

п	S	Terms differences	$\Delta(1/\lambda), cm^{-1}$	Δv , MHz	Δv_{exp} , MHz [24]
1	2	$(j'_{0,2} - y_{0,2})_{n=1}$	0.272617	8172.852	8172.837 (22)
	3	$(j'_{0,3} - y_{0,3})_{n=1}$	0.015355	460.3313	
2	2	$(j'_{0,2} - y_{0,2})_{n=2}$	0.0352859	1057.84466	1057.8446 (29)
	3	$(j'_{0,3} - y_{0,3})_{n=2}$	0.0032148	96.37727	

We see that at p = 0, the zero of the second *kinetic shell* [22] is $z_{0,2} = y_{0,2} = 3.95767842$; hence, from (4.1) it follows that

$$\lambda = 0.106315 \ cm. \tag{4.11}$$

The zero level of wave exchange (interaction with environment) is not perceived visually and integrally characterized by the absolute temperature of zero exchange. It exists as a standard energetic medium in the Universe. Actually, the wave (4.11) is within an extremum of the spectral density of equilibrium cosmic background. The absolute temperature of zero level radiation with this wavelength is

$$T = 0.290 (cm \cdot K) / \lambda = 2.72774 K.$$
(4.12)

The temperature obtained is close to the temperature of "relict" background measured by NASA's Cosmic Background Explorer (COBE) satellite to four significant digits $(2.728 \pm 0.002 \text{ K})$ [23].

The theoretical values obtained for the $(j'_{0,2} - y_{0,2})_{n=1}$ and $(j'_{0,2} - y_{0,2})_{n=2}$ terms differences (Table IV) almost coincide with the experimental values for the 1*S* and 2*S* Lamb shifts $L_{1,s} = 8172.837(22)$ MHz and $L_{2s-2p} = 1057.8446(29)$ MHz [24].

Accuracy of the first elementary calculations, presented in Tables, performed on the basis of (4.1), can be easily improved owing to the relative clarity with the factors which can be exposed to the possible corrections. Actually, only the constant A or A_e , defining the oscillation amplitudes at the sphere of the wave radius (kr = 1), can be changed in (4.3) or (4.4).

5. Magnetic Moment of an Electron; Derivation

The wave motion of the hydrogen atom, as a paired proton-electron system of the field of exchange, generates in the simplest case (in equilibrium) an elementary *electric* (*longitudinal*) *moment* (moment of the *basis* [14])

$$N_e = e(r_0 + \delta r_0) \tag{5.1}$$

and the corresponding magnetic (transversal) moment (moment of the superstructure)

$$\mu_{e} = \frac{\upsilon_{0}}{c} N_{e} = \frac{\upsilon_{0}}{c} e(r_{0} + \delta r_{0}), \qquad (5.2)$$

where the term δr_0 includes all small deviations of the orbital radius r_0 caused by different constituents of specific motion of the electron in the intra-atomic wave field; *e* is the electron's exchange charge (2.22), υ_0 is the oscillatory speed of boundary wave shell of the hydrogen atom equal to the Bohr speed (4.7), *c* is the base wave (phase) speed of the wave exchange [25] equal in value to the speed of light.

Thus, the first major term defining the magnetic moment of the electron, bound in the hydrogen atom, is

$$\mu_{e,orb} = \frac{\upsilon_0}{c} er_0 = 657.510152 \cdot 10^{-22} g \cdot cm \cdot s^{-1} = 1854.801894 \cdot 10^{-26} J \cdot T^{-1}.$$
 (5.3)

A half of this value

$$\frac{1}{2}\mu_{e,orb} = \frac{\upsilon_0}{2c}er_0 = \mu_B = 927.400947(80) \cdot 10^{-26} J \cdot T^{-1}$$
(5.4)

is called in physics the Bohr magneton.

We assume that the Rydberg constant is the constant also for the domain of the wave shell $(z_{p,s} = kr = 1)$ of the fundamental radius λ_e (2.24), then the constant (3.20) in this domain will have the following value

$$A_m = \hat{\lambda}_e \sqrt{\frac{2Rh}{m_0 c}} \,. \tag{5.5}$$

$$\delta r_{0,1} = \lambda_e \sqrt{\frac{2Rh}{m_0 c}} = 2.73065194110^{-12} \ cm \tag{5.6}$$

because the hydrogen atom, as a whole, oscillates with this amplitude in the spherical field of exchange. This quantity is the characteristic amplitude of oscillations on the wave sphere (at kr = 1).

From the previous sections it also follows that the wave motion causes oscillations of the wave shell together with the orbiting electron and oscillations of the center of mass of the hydrogen atom with the amplitude (3.6). These oscillations superimpose on (modulate) the orbital motion of the electron (trajectory), defining the second in value term of δr_0 , which we must take into account at the calculation. The constant *A* in the amplitude (3.6) has the form (3.20) (for the case of $z_{p,s} = z_{0,s}$, when $|\hat{e}_0(kr_s)|^2 = 1$), hence, the second constituent of δr_0 is

$$\delta r_{0,2} = \frac{r_0}{z_{0,s}} \sqrt{\frac{2Rh}{m_0 c}} \,. \tag{5.7}$$

In the simplest case, we take the first root of the spherical Bessel functions of the zero order $z_{0,s} = b'_{0,1} = 2.79838605$ [22], responding to the extremum of the first kinetic shell [20], then

$$\delta r_{0,2} = \frac{r_0}{b'_{0,1}} \sqrt{\frac{2Rh}{m_0 c}} = 3.21948354610^{-13} \, cm \,. \tag{5.8}$$

Like a proton or any elementary particle, an electron is a spherical dynamic formation as well. Therefore, oscillations of the center of mass of the electron itself, as a whole, with respect to the center of mass of the hydrogen atom, also occur. The third (smallest in value) constituent of δr_0 takes into account these oscillations; it is presented in the form

$$\delta r_{0,3} = \frac{r_e}{z_{0,s}} \sqrt{\frac{2Rh_e}{m_0 c}}, \qquad (5.9)$$

where r_e is the theoretical (2.25) wave radius of the electron,

$$h_e = 2\pi m_e \upsilon_0 r_e \tag{5.10}$$

is the orbital action of the electron (analogous to the Planck constant *h*) produced at its own rotation around own center of mass with the speed v_0 , realized during the electron orbiting around the proton with the same speed.

In this case, owing to the more indeterminacy, we take the two nearest roots $z_{0,s}$ of Bessel functions: $y'_{0,1} = 2.19714133$ equal to the extremum of the first kinetic shell, and $y_{0,1} = 0.89357697$ [22] equal to the zero of the first kinetic shell. In view of this, (5.9) yields the value

$$\delta r_{0,3} = r_e \frac{(y_{0,1} + y'_{0,1})}{2y_{0,1}y'_{0,1}} \sqrt{\frac{2Rh_e}{m_0c}} = 1.56898159810^{-14} \, cm \,. \tag{5.11}$$

The total magnetic moment of the electron is defined by the sum of all terms of μ_e considered above:

$$\mu_{e} = \mu_{e,orb} + \delta \mu_{e,1} + \delta \mu_{e,2} + \delta \mu_{e,3}, \qquad (5.12)$$

where

$$\delta\mu_{e,1} = \frac{e\upsilon_0}{c} \,\delta r_{0,1}, \qquad \delta\mu_{e,2} = \frac{e\upsilon_0}{c} \,\delta r_{0,2}, \qquad \delta\mu_{e,3} = \frac{e\upsilon_0}{c} \,\delta r_{0,3}. \tag{5.13}$$

Thus, the theoretical value of the total magnetic moment (5.12) of the electron $\mu_e(th)$ is presented in an expanded form as

$$\mu_{e}(th) = \frac{e\upsilon_{0}}{c} \left[r_{0} + \left(\frac{c}{\omega_{e}} + \frac{r_{0}}{b_{0,1}'}\right) \sqrt{\frac{2Rh}{m_{0}c}} + r_{e} \frac{y_{0,1} + y_{0,1}'}{2y_{0,1}y_{0,1}'} \sqrt{\frac{2Rh_{e}}{m_{0}c}} \right].$$
(5.14)

The values of the fundamental quantities (CODATA), used for the calculation by (5.14), are as follows: $r_0 = 0.529177210$ (\$18) $\cdot 10^{-8}$ cm, h = 6.626069 (\$11) $\cdot 10^{-27}$ erg $\cdot s$,

 $m_0 = 1.6726217(29) \cdot 10^{-24} g$, and $c = 2.9979245810^{10} cm \cdot s^{-1}$.

The value of the electron mass we used,

$$m_e = 9.1093825 \,\mathfrak{g}(18) \cdot 10^{-28} \,g \,, \tag{5.15}$$

was derived from the CODATA value for the Planck constant over 2π , knowing v_0 (4.7) and r_0 values, taking into account that $\hbar = m_e v_0 r_0 = 1.0545716$ (18) $\cdot 10^{-27} erg \cdot s$. For comparison, the CODATA recommended value of m_e is 9.109382 (16) $\cdot 10^{-28} g$.

The substitution of numerical values for all quantities entered in (5.14) gives the following theoretical values for the total magnetic moment of the electron and its constituents:

$$\mu_e(th) = (657.510152 + 0.3392873572 + 0.0400025379 + + 0.00194948177) \cdot 10^{-22} g \cdot cm \cdot s^{-1} = 657.8913914 \cdot 10^{-22} g \cdot cm \cdot s^{-1}$$
(5.16)

In the SI units, since $1T = 10^4 / \sqrt{4\pi} \ cm \cdot s^{-1}$, Equality (5.16) is rewritten as

$$\mu_e(th) = (1854.801894 + 0.957111963 + 0.112845073 + 0.0054993865) \cdot 10^{-26} J \cdot T^{-1} = 1855.877351 \cdot 10^{-26} J \cdot T^{-1}$$
(5.17)

The ratio of electron's orbital magnetic moment $\mu_{e,orb} = \frac{\upsilon_0}{c} er_0$ to its orbital moment of momentum $\hbar = m_e \upsilon_0 r_0$,

$$\frac{\mu_{e,orb}}{\hbar} = \frac{e}{m_e c} = \frac{m_e \omega_e}{m_e c} = \frac{1}{\lambda_e} = k_e , \qquad (5.18)$$

coincides with the same ratio obtained in Einstein-de-Haas's experiment and is equal to the wave number k_e of the fundamental frequency ω_e . The erroneous theoretical value for this ratio accepted in contemporary physics,

$$\frac{\mu_{e,orb}}{\hbar} = \frac{e}{2m_e c} \,,$$

is half as much the ratio (5.18). An error in the latter equality (unfortunately, accepted in physics) originates from the erroneous theoretical derivation of the average value of circular current caused by the orbiting electron in the hydrogen atom, that is convincingly shown in [26]. From this fact it follows that the electron does not have the spin of one half of its orbital moment of momentum, $\mu_s = \frac{1}{2}\hbar$, (ascribed to the electron in order to achieve the correspondence of the true experiment with the erroneous, as it turned out, theory existed at that time) just like the electron does not have the corresponding magnetic moment of one half of the electron.

If one subtracts the value (5.4) of one Bohr magneton μ_B (ascribed, as turned out erroneously [26], to the spin magnetic moment) from (5.17), we obtain the absolute value

$$\mu_{e} = \mu_{e}(th) - \mu_{B} = 928.476404 \cdot 10^{-26} J \cdot T^{-1}, \qquad (5.19)$$

which coincides with the absolute "2002 CODATA recommended value" accepted for the magnet moment of the electron (within uncertainty in the last two figures):

$$\mu_{e,CODATA} = 928.476412(80) \cdot 10^{-26} J \cdot T^{-1}.$$
(5.20)

The smallest in value term (5.11) in the resulting expression (5.17) contains indeterminacy in weight contributions of two items defined by two roots of Bessel functions, $y_{0,1}$ and $y'_{0,1}$. These roots correspond to the zero and extremum of the first kinetic shell of the electron. If we introduce a small empirical coefficient for this term, that is justified in the framework of the indicated indeterminacy, $\beta = 1.00155$, then the last term in (5.17) will be

$$\delta\mu_{e,3} = \frac{e\upsilon_0}{c} r_e \frac{\beta(y_{0,1} + y'_{0,1})}{2y_{0,1}y'_{0,1}} \sqrt{\frac{2Rh_e}{m_0c}} = 5.50792 \cdot 10^{-29} J \cdot T^{-1}.$$
 (5.21)

In this case the theoretical magnetic moment of the electron takes the value

$$\mu_e(th) = 1855.877359 \cdot 10^{-26} J \cdot T^{-1}$$
(5.22)

As a result, the theoretical value of μ_e coincides completely with the current (recommended) experimental one (5.20):

$$\mu_e = \mu_e(th) - \mu_B = 928.476412 \cdot 10^{-26} J \cdot T^{-1}.$$
(5.23)

We see that among all terms, the only quantity entered in (5.13), namely $\delta \mu_{e,3}$, has the direct relation to the electron proper (spin) magnetic moment, caused by the rotation of the

electron around its own axis of symmetry. On this basis, we have the right to ascribe the value (5.21) to the *electron spin magnetic moment*, so the later is

$$\mu_s = \delta \mu_{e,3} = 5.50792 \cdot 10^{-29} J \cdot T^{-1}.$$
(5.24)

Obviously, the contribution of (5.24) to the total magnetic moment of the electron (5.22) is insignificant and is less than 0.0003%. Erroneousness of the introduction in physics the $\hbar/2$ value to electron's proper moment (spin) and the introduction of the corresponding value $\mu_B = ev_0 r_0/2c$ (called the Bohr magneton) to electron's spin magnetic moment is analyzed in detail in the work [26].

6. Conclusion

In view of the data obtained, the observation of the cosmic microwave background, the Lamb shifts and the magnetic moment of an electron provide the strong evidence for the existence of zero level radiation of hydrogen (and, apparently, any) atoms in the Universe. They justify in favor of the validity of the background spectrum expressed by the formula (4.1) (with allowance for (4.10)) and of the Dynamic Model of Elementary Particles [12], which is the basis model used for the derivation of the spectrum.

Owing to the DM, which led to the formula of the background spectrum of the hydrogen atom, the common nature of two phenomena found in the 20th century, the Lamb shift and "relict" background radiation (cosmic microwave background, CMB), was revealed. The validity of the above conclusion was confirmed by the precise derivation of the magnetic moment of an electron carried out for the first time on the basis of the DM, beyond QED.

A discovery of such a fundamental regularity in Nature is a logical result of an advantage of the new theoretical basis used here. As was mentioned in Section 2, the DM revealed the nature of mass, the nature and the true dimensionality of the electric charge. The latter is defined in the DM as the *rate of mass exchange*. With this, the unknown earlier fundamental constant, namely the *fundamental frequency of exchange* (interaction) at the atomic and subatomic levels ω_e , was found, *etc*. Without aforementioned (and others not mentioned here) revelations, which show an advantage of the DM as against the Standard Model of Elementary Particles, the results presented could not be appeared.

The background spectrum obtained contains the line of the wavelength $\lambda = 0.106315 \, cm$ corresponding to the 2.728 K temperature. The radiation of such a temperature exists in cosmic space just because of immense abundance of hydrogen there that was measured by research satellites [23]. The hydrogen hypothesis of the origin of cosmic microwave background is confirmed by the energetic structure of the background spectrum of the hydrogen atom. Actually, the frequency gaps 8172.852 MHz and 1057.8447 MHz between the nearest background terms (see Table 1V) coincide with high precision with the most accurate experimental values [24] obtained for the 1S and 2S Lamb shifts of the hydrogen atom.

The words "splitting" or (Lamb) "shift" are not correct names for the observed phenomenon. All background terms described by the resultant formula (4.1), with taking into account (4.10) (contained the roots of Bessel functions), are primordially inherent features of the hydrogen atom; so that they neither "split" nor "shift". Accordingly, we should speak only about the energetic differences (or frequency gaps) between the existed background terms.

An advantage of a new theory explained origination of the magnetic moment of an electron without QED and QCD concepts is clearly seen from the all above considered.

Actually, as was mentioned in Introduction, the coefficient of the α^4 term in the QED formula (1.7) for the magnetic moment anomaly of the electron consists of more than one hundred huge 10-dimensional integrals. Whereas, Equation (5.14), derived on the basis of the Dynamic Model of Elementary Particles, does not contain any integrals, but nevertheless logically and non-contradictory leads to the same precise value of μ_e . Moreover, the current QED precise value of μ_e (or $\alpha_e(th)$) has been achieved in the course of more than 50 years of hard efforts of many skilled theorists over the World. The precise derivation based on the DM did not require so much time and huge efforts.

A general formulation developed deals with the physical quantities whose nature was uncovered by the DM. First of all it concerns the electron charge and mass. The correctness of the dimensionality of electric charges, $g \cdot s^{-1}$, (used in this paper for the calculation of μ_e) originated from the DM [12] as the *rate of mass exchange* is verified thus here. All these facts confirm the correctness of the wave concept on the nature and behavior of elementary particles (matter). They show still unexhausted possibilities of classical approaches to the description of physical phenomena.

We see that the results presented call in questions some accepted hypotheses, concepts, and theories. **First**, they touch a hypothesis of the origin of CMB of the 2.7 K temperature regarded by the majority as a "relict" background radiation left after the Big Bang. A historical and critical analysis of theories explaining the origin of the 2.7 K background temperature can be found in [27]. **Second**, they nonplus the QED concept of "virtual" particles introduced initially just for explanation of the Lamb shifts and "anomalous" magnetic moment of an electron [19]. **Third**, these results question the quantum mechanical *probabilistic* atomic model in which the notion of the *trajectory* of motion (along which an electron moves around a proton) is excluded of principle [28, 29].

In addition, the next very importance problem which is also solved on the basis of the DM (that was not considered here) is the *unified description of three fundamental interactions*: electromagnetic, gravitational and strong [14]. An analysis of the results, obtained in this field, leads us to the conclusion that, apparently, in the framework of the DM as well, one can solve the problem of antigravitation that is the subject of the next consideration.

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