

Some words about fundamental problems of physics

Part 3: Virtual particles

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In previous two Parts of short analytical articles I have shown that modern concepts of atomic physics, based on made-up postulates which do not reflect reality, are erroneous. Inadmissibility of using such postulates as the basis for construction of physical theories was convincingly brought to light there. In this (3rd) Part of the articles I touch quantum electrodynamics (QED). Unfortunately, fundamental concepts of QED are also mystic postulates. By this reason, at once one can say, with the full responsibility, that the QED theory is erroneous as well. Nevertheless, oddly enough, QED is still the basic theory of modern physics. Thus, just like quantum mechanics, whose concepts were analysed in Parts 1 and 2, the theory of QED is based on a series of fictional postulates. The central place of them takes the postulate on existence of the so-called virtual particles.

Theorists have introduced such a mystic notion for explaining insignificant, but observable disturbances of electron's motion in the hydrogen, deuterium, and hydrogen-like atoms that become apparent in the characteristic fine-structure of lines found in their optical spectra. The disturbances are manifested in a relative shift (de-degeneracy, "splitting"), called the Lamb shift, of $2S_{1/2}$ and $2P_{1/2}$ quantum levels, where the aforementioned p -state is turned out below the s -state, and also in anomalous magnetic moment of the electron.

Having found these phenomena, the theorists were faced with the deviation from a theory existing to that time, in which the electron g -factor equal to 2 was used. Not analysing thoroughly enough all possible real causes, in order to explain the found phenomena (the Lamb shift and the anomalous magnetic moment of the electron), they began creating a new theory based on mystic notions. Since then, for more than 60 years, with the gradual improvement and increasing accuracy in theoretical derivation of magnitudes for both phenomena, on the basis of the aforementioned erroneous postulates, the modern theory of QED was established and fully developed. What opportunities were missed (ignored) herewith, and which results were reached in QED? We proceed to discuss these questions.

Let us think and ask ourselves. Which influences in principle can be responsible for perturbations of orbital electron motion in the hydrogen atom, and wherewith they are conditioned? Obviously, we should consider and analyze first of all two very obvious possible areas of their origin, internal (inherent) and external. Here they are.

Firstly, an influence of natural processes conditioned by intraatomic dynamics of constituent particles (proton and electron) must be studied. Of course, inherent causes can be regarded as real if only we will consider the proton as a dynamic, elastic, and mobile micro formation being in a continuous state of motion, but not like a rigid static microobject in the form of a

tiny solid nucleus of the hydrogen atom with an enormous density of about $4 \times 10^{14} \text{ g/cm}^3$ (as is believed in modern physics). The same assumption must concern the electrons also, which are still regarded in modern theoretical physics as point-like particles. The supposed intraatomic dynamic processes, if really exist, about that we have no doubt, must be reflected in peculiarity of binding between the constituent particles and, naturally, in electron motion.

Secondly, one should estimate the possibility of influence on electron's orbital motion the environment, including a field of the physical vacuum.

As we see, judging by the course of the development of physical ideas, the first option (intraatomic inherent processes) was not discussed, generally, by theorists. The current model of the atom was not questioned, and no intentions to revise it were arisen, even though the experimentally obtained data clearly showed an inadequacy of the existing model. The hydrogen atom was considered (and is still considered so) as a tightly coupled centrally symmetric system consisting of a stationary proton (nucleus) surrounded by an electron moving within atomic "orbitals" (see Part 1) in obedience to the probabilistic laws of quantum mechanics (or moving along the closed trajectory, an orbit, if we rely on the Bohr model of atoms).

1. Therefore, theorists have focused only on the second of the indicated above options – on a probable external influence from environmental space. And, following the well-trodden path of their predecessors, they have begun to invent by offering abstract postulates (mystic scenarios). According to the hypothesis, adopted with the course of time as basic for a quantum field theory, the interaction of particles and their mutual transformations are realised through the virtual particles generated and absorbed by free particles. It means that any particle continuously emits and absorbs virtual particles of various types. In particular, an electron, bound in the atom, emits and absorbs virtual photons that lead to a change the effective electron mass and an appearance of electron's anomalous magnetic moment. The shift of the aforementioned s-and p-levels is regarded as the effect of interaction between an electron moving along its orbit and virtual particles swarming in the surrounding vacuum.

The process of appearance and disappearance of particles from the vacuum lasts an arbitrarily short time, so that in principle it is not possible to detect these particles by any detector, hence the name - virtual (imaginary, fictitious, ..., in short, unreal) particles. Thus, due to fluctuations of the zero-field of the vacuum caused by continuous generating and absorbing virtual particles, the orbital motion of an electron in an atom is subject to the additional random motion. As a result, according to QED, the main contribution to the Lamb shift, caused by the influence of virtual particles, give the following effects:

1. A change (renormalization) of effective electron mass and charge.
2. Anomalous magnetic moment of the electron.
3. Continuous creating out of the vacuum of virtual short-lived electron–positron pairs and their speedy annihilation (the so-called effect of vacuum polarization).

On the basis of accepted postulates, an elementary mathematical fitting of the theoretical values of electron's anomalous magnetic moment and the Lamb shift to their experimentally obtained values has begun. It continues to this day, with progress in experimental technique and getting more and more accurate numerical data for these quantities. Thus it appeared and fully developed the theory of QED. To what it has come? Let us analyse taking as a particular case the derivation of anomalous magnetic moment of an electron.

The anomalous magnetic moment of the electron is usually expressed for convenience by the so-called anomaly:

$$\alpha_e = \frac{g_e - 2}{2}, \quad (1)$$

where g_e is the electron g -factor (in a semiclassical theory $g = 2$, see Part 2).

How far have advanced the theory of QED, and to what extent of absurdity has reached up the mathematical fitting to the experiment herewith, one can judge by an extremely complex and cumbersome resulting formula for the anomaly (1) derived in the framework of the QED theory. In the completely unfolded form, it is not possible to put this formula, even in a hundred pages of the text, because of the extremely cumbersome mathematical expressions for the coefficients in each of the members of the formula, presented in the form of an expansion in powers of the fine structure constant α . Therefore, only a compact form of the really enormous theoretical formula for the anomaly, $\alpha_e(th)$, without mathematical expressions for the coefficients of the expansion in the formula, but with already calculated (to 2003) numerical values for all them, is demonstrated here:

$$\begin{aligned} \alpha_e(th) = & 0.5 \left(\frac{\alpha}{\pi} \right) - 0.328478965579 \dots \left(\frac{\alpha}{\pi} \right)^2 + 1.181241456 \dots \left(\frac{\alpha}{\pi} \right)^3 - \\ & - 1.5098(384) \left(\frac{\alpha}{\pi} \right)^4 + 4.382(19) \times 10^{-12} = 0.0011596521535(12) \end{aligned} \quad (2)$$

Thus, $\mu_e \neq \mu_B$, because $g_e > g$, or owing to an appearance of «anomaly» α_e (1); namely

$$\mu_e = (1 + \alpha_e) \mu_B \quad (3)$$

Compare with the formula (16) of Part 2, where $\mu_e = \mu_B$.

As I have mentioned already, the expression (2) in a completely unfolded form is extremely complex and cumbersome. Actually, for example, the coefficient 1.5098(384) of the forth

term, at $\left(\frac{\alpha}{\pi} \right)^4$, in the expression (2) (obtained with a big uncertainty in the last three signs, ± 384), is the result of calculation of more than 100 huge 10-dimensional integrals. Therefore, because of the complicated mathematical structure of the coefficients of the terms, a special system of massively-parallel computers of high efficiency (actually, supercomputers) was developed for this purpose. In fact, we are witnessing the skilfully mathematical fitting, which have reached the highest degree of perfection for more than 60

years since the first works of 1947 by H. A. Bethe and T. A. Welton, thanks to strenuous efforts of many experienced theorists from around the world and developing computing means. Incidentally, the last small term in (2) takes into account the contribution of quantum chromodynamics....

You see that theoreticians build, actually, something like the "Tower of Babylon". Why such an analogy? The reason for this comparison follows from all that was described above. And I will try to confirm the validity of the analogy additionally by showing how simply the problem is solved if we will rely on the common sense and logic.



2. Let us come down from this "tower" to the ground. Consider the first of the aforementioned options (intraatomic inherent processes) most likely responsible for perturbations of orbital motion of an electron in the hydrogen atom, from our point of view. These verisimilar causes by nobody were taken into account heretofore and, hence, never discussed. Obviously, in order to take this option it was necessary primarily to reconsider an internal structure of individual atoms, to answer the natural question, is the atomic model accepted in contemporary physics adequate to reality, whether or not?

If we assume that the source of disturbances to the moving electron, being in an atom in a not excited (isolated from external influences) state, are inherent in the atom its own intra-atomic processes, we must recognize that the atom is the dynamic system vibrating as all in the Universe, rather than a hard static microformation. Hence, the need arises to revise the officially accepted quantum-mechanical (and, in fact, Rutherford-Bohr) atomic model.

Where to start? In our opinion we should start with the definition of the most common properties inherent to any real objects and processes in nature. Acting in this way, we will arrive at the characteristic property of the atom, which could not give rise to any doubts. Then, taking into account this revealed (inherent, universal) property, we can begin building an appropriate model of the atom more adequate to reality.

What is the property that we can accept without any doubts as a real postulate, as a self-evident phenomenon really existing? Look, everything in nature at all levels is in a constant motion. More precisely, everything in the Universe at all levels, including micro-and mega-, is in continuous oscillatory-wave motion. Everything in the Universe is subject to the law of

rhythm. Continuous mutual transformations of fields with opposite properties (e.g., potential field \Leftrightarrow kinetic field) give rise to the wave nature of the World (and are conditioned by the latter). This means that the fields of all objects in nature are wave. Everything in nature exists in a natural harmony. Accordingly, between all fields, including electromagnetic and gravitational, as well as between any of the objects and phenomena, there is a natural harmonic interrelation. And this is no doubt a fundamental property of the world around us. In this case, following the stated above, we must recognize that the properties of objects and processes in nature must obey and be described by the universal (classical) wave equation.

Considering this, on the basis of the postulate of the wave nature of all objects and phenomena in Universe, solving the universal (classical) wave equation, we have arrived at the Wave Model (fundamentally differing from the Standard Model of modern physics), on the basis of which the new theories: a wave Dynamic Model of elementary particles (DM) [1] and Shell-Nodal (or, in other words, Shell-Wave) atomic model [2], were developed. Based on the new theories, the problem on the anomalous magnetic moment of the electron [3, 4] and the Lamb shift [4, 5], discussed in this article, were solved relatively simple and logically impeccable.

According to DM, the centers of mass of a hydrogen atom as a whole, as well as a proton and an electron separately, and their wave shells are subject to constant wave influence, caused by the wave nature of the structure and behaviour of elementary particles. Therefore, they are constantly fluctuating with a certain frequency and amplitude, in a state of equilibrium also. Perturbing the orbital motion of electrons on the fundamental frequency of the wave exchange, they produce the natural (background) oscillations of the electron in a hydrogen atom at this frequency.

Natural (incessant) intra-atomic vibrations disturb (superimposed on) electron's orbital motion, resulting in the formation of a zero-level spectrum – the spectrum of a background radiation. It turned out that the line of the background radiation at the maximum corresponds to the temperature 2.7 K. The difference in the energies of the nearest terms of the background spectrum corresponds exactly in value to the 1S and 2S Lamb shifts.

This fact indicates at the natural bond between the Lamb shift and the background spectrum, uncovering thus the origin of the Lamb shift and additionally confirming the correctness of the theoretical derivation of the background spectrum. These discoveries were possible due to aforementioned new theories, which were fully developed with taking into account the wave nature of all objects and phenomena in nature.

The anomalous magnetic moment is easily explained in DM on the basis of the wave notions (without involvement of virtual particles of QED); the formula of the moment is derived relatively simple and logically noncontradictory [3, 4]. Here is its unfolded detailed form:

$$\mu_e(th) = \frac{e\nu_0}{c} \left[r_0 + \left(\frac{c}{\omega_e} + \frac{r_0}{b'_{0,1}} \right) \sqrt{\frac{2Rh}{m_0c}} + r_e \frac{y_{0,1} + y'_{0,1}}{2y_{0,1}y'_{0,1}} \sqrt{\frac{2Rh_e}{m_0c}} \right], \quad (4)$$

where $b'_{0,1}$, $y_{0,1}$, $y'_{0,1}$ are roots of Bessel functions (radial solutions of the wave equation); R is the Rydberg constant; r_0 is the Bohr radius; r_e is the theoretical radius of the wave shell of the electron; ω_e is the fundamental frequency of atomic and subatomic levels; h_e is the orbital action of the electron (analogous to the Planck constant h), conditioned by its rotation around own center of mass with the Bohr speed ν_0 ; e is the elementary quantum of mass exchange (electron “charge”, dimensionality $g \times s^{-1}$); m_0 is the associated mass of the proton; c is the basis speed of the wave exchange at the atomic and subatomic levels, equal to the speed of light in vacuum. (r_e , ω_e , h_e , e , m_0 , and c are unknown earlier parameters originated from DM).

Eq. (4) takes into account: the oscillations of the hydrogen atom as a whole in a spherical field of exchange, oscillations of its wave spherical shell together with an orbital electron, oscillations of the center of mass of the hydrogen atom, oscillations of the center of mass of the electron as a whole relative to the center of mass of the hydrogen atom. All of these oscillations are superimposed (modulate) the orbital motion of the electron and as a result are manifested in the form of the phenomena of the "anomalous" magnetic moment and the Lamb shift. All the details of the physical meaning of each term in Eq. (4) and its derivation can be found in [1, 3-5].

Note that in Eq. (4), there are no integrals, and there is a clear understanding of the physical meaning of all terms in it. "Anomalous" magnetic moment is derived simply and logically in the framework of a new approach that we applied to solving the problem, and, as a result, the moment is easily calculated. Resulting data have the same high accuracy, which has been reached in QED for many decades that took for the mathematical derivation of Eq. (2), owing to enormous efforts of many groups of theorists. Moreover, Eq. (4) is easily calculated using the **calculator** that is impossible to apply for the calculations of “anomaly” by Eq. (2). Remind that for calculations of extremely awkward expression (2), derived in QED on the basis of abstract (imaginary, unreal) postulates, resulted in appearing a several hundred of the huge ten-dimensional integrals, and, hence, in order to calculate the electron’s “anomalous” magnetic moment (3), one needs **supercomputers**.

Thus, we see that the postulates of the postulates of strife. The Standard Model of modern physics is based mainly on abstract (unrealistic) postulates. The Wave Model that we have developed is based on the postulates reflecting reality. Hence, the corresponding striking results were obtained, as clearly shown in the examples considered in two previous (1st and 2nd) Parts and in this 3rd Part of the articles. A comparison of both theoretical approaches is not in favour of those accepted in modern physics that dominate currently.

Here is a well-known statement of Richard Feynman. *“The theory of quantum electrodynamics describes Nature as absurd from the point of view of common sense. And it agrees fully with experiment. So I hope you accept Nature as She is — absurd”* [6].

He was right in part. Actually, QED *“describes Nature as absurd from the point of view of common sense”*. Everybody will agree with this completely. But I hope nobody can agree with Feynman’s last statement. It is stupidly to *“accept Nature as She is — absurd”* only because Nature is described by QED so absurdly. His second statement that *“it agrees fully with experiment”* nothing speaks about efficiency and truthfulness of the QED theory, etc. As once was noted [7], *“the correspondence of any theory with experiments done so far does not quite mean that the given theory is true and uniquely possible. Moreover, the possibilities of modern mathematics are so impressive that it can represent any abstract absurdity as a profound theory (or its development), and fit that to any experiment”*.

How an agreement with experiment is achieved in QED, with what efforts, you have convinced on an example of the derivation by QED of $\mu_e(th)$ that led to enormous Eq. (2). Compare the latter with elegant Eq. (4) obtained by the Wave Model. Accordingly, the opposite option is applied, namely **QED is absurd**, but not Nature. It seems obvious, because we must tend not only to describing experiments at any cost, but along with this endeavour to cognize Nature. For this purpose abstract-mathematical theories like QED are not valid in principle. This is why primordial problems of physics, such as the nature of electric charges and the origin of mass of elementary particles, magnetic moments of nucleons (proton and neutron), and etc., are not solved in the Standard Model including QED. To the point, these problems are naturally solved in the framework of the Wave Model.

Do we need a virtual physics (and, in fact, science fiction)? Is it time to change the paradigm in physics? I think the answer to these questions is clear to all. According to this, we need to pull the physics out of the impasse in which it resides.

A reliance on the real postulate on the wave nature of all phenomena and objects in the Universe has led us to unique results. The dynamic model of elementary particles [1] and shell-nodal (shell-wave) model of the atom [2] were developed. On their basis, we have come to the discovery according to which the three phenomena considered above have a common source (hydrogen atoms) of their origin and a single mechanism responsible for their appearance (wave nature). All these phenomena are caused by the wave nature of elementary particles, constituent of the atoms. Let us remind once again, in the end of this article, these phenomena. Here they are:

- (1) The "anomalous" magnetic moment of an electron.
- (2) The background radiation of hydrogen atoms with a black body spectrum corresponding to the temperature of 2.7 K (erroneously ascribed to a mystic "relic" radiation, allegedly remaining after the hypothetical "Big Bang").

- (3) The Lamb shift, which is a difference between adjacent energy levels in a spectrum of microwave background radiation of hydrogen atoms.

So, whether you want to continue building the "Tower of Babel" of virtual particles?

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