Quantum electrodynamics:

fundamentals and prospects

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Contents

Introduction

Quote from Encyclopaedia Britannica:

"*Quantum electrodynamics (QED), quantum field theory of the interactions of charged particles with the electromagnetic field. It describes mathematically not only all interactions of light with matter but also those of charged particles with one another. QED is a relativistic theory in that Albert Einstein's theory of special relativity is built into each of its equations. Because the behaviour of atoms and molecules is primarily electromagnetic in nature, all of atomic physics can be considered a test laboratory for the theory. Some of the most precise tests of QED have been experiments dealing with the properties of subatomic particles known as muons. The magnetic moment of this type of particle has been shown to agree with the theory to nine significant digits. Agreement of such high accuracy makes QED one of the most successful physical theories so far devised*".

Opinion (underlined), constantly imposed by the media, misleads people. However, the time has come when we can say what the QED theory represents by essence in reality.

Among the concepts underlying QED, the following first two are very important key ones:

1. The *average* value of the *electric current*, generated by an orbiting electron in a hydrogen atom, which is still believed, is determined by the following equality,

$$I = \frac{e}{T_{orb}}$$

2. The *electron spin* of the unrealistically huge value of

$$\frac{1}{2}\hbar$$

This notion was introduced into physics subjectively when describing the Einstein-de Haas effect using the electric current formula mentioned above.

As we found out, the *concepts* mentioned above turned out to be *erroneous*. As a result, they gave rise to *spin-mania* in physics and led to the introduction of a long chain of *subsequent erroneous concepts*. Ultimately, on this basis, Quantum Electrodynamics was created. We will show this here.

The notions of spin and spin magnetic moment (corresponding to the spin) play a crucial role in electromagnetism. The introduction of the concept of spin, for the first time for an electron, became the beginning of a wide application of this concept in physics. Indeed, after the electron, the notion of spin was attributed to all elementary particles.

As a result, by the present day the physical parameters associated with the spin have formed in a group of the most important irreplaceable parameters of modern physics, constituting its foundation along with all other physical parameters.

Our studies have shown, however, that physicists made a fundamental error, unreasonably recognizing the hypothetical electron spin $\hbar/2$ (fictional parameter) as a real parameter of the electron. Analyzing all the data related to electron spin, we found that in fact physicists are not dealing with their own mechanical moments (spin) of free electrons and own magnetic moments corresponding to the spin, as they believe, but with orbital mechanical and orbital magnetic moments of electrons bound to atoms, i. e., they deal with the magnetic moments of atoms.

This report focuses on the rationale for this discovery and analysis of the consequences for physics caused by the introduction of the electron spin concept.

The history of introducing the concept of electron spin is associated with the Einstein-de Haas experiment on the determination of the magnetomechanical ratio (1915). They relied on Bohr's atomic model. From their experiment it follows that the ratio of the magnetic moment of an orbiting electron to its mechanical moment exceeded in two times the expected value (which followed from calculations).

Calculation of the orbital magnetic moment of an electron in an atom was carried out according to a simple formula: $\mu_{orb} = (I/c)S$, where the average value of the electric current I, produced by an electron moving in orbit, was determined by the formula $I = e/T_{orb}$ as described in all sources, including fundamental university textbooks on physics.

Our research has shown, however, that this formula is erroneous. Namely, the average current I is twice as large [1]. This is why, the calculated orbital magnetic moment of the electron μ_{orb} turned out twice less of experimentally obtained.

To compensate the lost half of the orbital magnetic moment, made at the calculations (caused, as we revealed, due to using the erroneous value of current I in the formula $\mu_{orb} = (I/c)S$), the concepts of own mechanical moment (spin) of an electron of a relatively huge absolute value $\hbar/2$ and its corresponding (spin) magnetic moment, equal to exactly the lost half, were eventually subjectively introduced into physics.

Over time, the opinion has fully formed that the presence of an intrinsic mechanical moment of an electron (spin) of value $\hbar/2$ is a real fact. However, this is a sad misconception, only faith. There is no direct evidence of this feature! Information on the detection of the spin magnetic moment on free electrons (unbound with atoms) is absent.

I will try to explain where and why an inexcusable error (fateful for the development of physics) was made, which led to introducing into physics (unreasonably, as we revealed) of the above-mentioned inadequate notions with the following values attributed to them for the electron spin and the spin magnetic moment of an electron, respectively:

$$\frac{1}{2}\hbar \qquad \text{and} \qquad \mu_{e,spin} = \frac{e\hbar}{2m_e c}$$

As a consequence, the introduced spin concept laid the foundation for erroneous theoretical constructions.

Part 1. Initial concepts

1. Electron spin $\hbar/2$ and spin magnetic moment.

How did the concept of "electron spin" appear in physics, moreover, of such a relatively huge magnitude as $\hbar/2$? Why huge? And what is $\hbar$? Let's look at all this in detail:

A physical constant h, the Planck constant, is the quantum of action, central in quantum mechanics. Planck's constant divided by 2π, $\hbar = h/2\pi$ is called the reduced Planck constant (or Dirac constant). Both these parameters, h and $\hbar$, are fundamental constants of modern physics.

In magnitude, the *constant* $\hbar$ is exactly equal to the *orbital moment of momentum* (or *angular* momentum or *rotational* momentum) of the electron in the first Bohr orbit, according to the Rutherford-Bohr atomic model, and is a quantum of this moment:

$$\hbar = m_e \upsilon_0 r_0 \tag{1.1}$$

where m_e is the electron mass, υ_0 is the first Bohr speed of the electron moving around a proton in the hydrogen atom, r_0 is the radius of the first Bohr orbit.

In quantum mechanics, there is no concept of the trajectory of the electron motion and, correspondingly, there are no circular orbits along which electrons move. Accordingly, there is no concept of speed of motion along orbits, just as there is no concept of the radii of such non-existent orbits.

Moreover, in quantum theory, according to the uncertainty principle, conjugate variables such as the particle speed υ and its location r cannot be precisely determined at the same time. Therefore, the above two parameters cannot be presented together in the corresponding equations of the given theory.

For the reasons stated above, formula (1.1) and the formula for h,

$$h = 2\pi m_e \upsilon_0 r_0 \tag{1.2}$$

do not make sense in quantum physics and are practically not mentioned.

It should be noted that in the spherical field of an atom the product of the orbital radius r_n and angular velocity υ_n of the electron is the constant value, $\upsilon_n r_n = const$. Accordingly,

$$\hbar = m_e \upsilon_0 r_0 = m_e \upsilon_n r_n$$

The true, classical origin of the constants $\hbar$ and h is simply hushed up.

However, the history of introducing the concept of electron spin is associated with the rotational momentum $\hbar$ (1.1). And everything began with the Einstein and de Haas experiments on the determination of the magnetomechanical (gyromagnetic) ratio (1915). They adhered to the Bohr model of the atom [2].

From the Einstein-de Haas experiments it follows that the ratio of the orbital magnetic moment of the electron, moving along the Bohr orbit, $\mu_{orb,\exp}$, to its orbital mechanical moment — moment of momentum, $\hbar = m_e \upsilon_0 r_0$, is

$$\frac{\mu_{orb,\exp}}{\hbar} = -\frac{e}{m_e c} \tag{1.3}$$

This result, as it turned out, exceeded twice the expected value (theoretical), following from the calculations:

$$\frac{\mu_{orb,th}}{\hbar} = -\frac{e}{2m_e c} \tag{1.4}$$

(the minus sign indicates that the direction of the moments are opposite).

Being absolutely sure of the infallibility of deducing the orbital magnetic moment of an electron $\mu_{orb,th}$ (in (1.4)), instead of looking for an error in it (in two times!), the physicists have chosen another way out of the situation with which they faced.

To compensate for the lost half in μ_{orb}, they advanced the idea that the electron has its own mechanical moment exactly equal to $\hbar/2$.

If only such a moment actually exists, consequently, an electron as a charged particle must also have its own magnetic moment corresponding to the own mechanical moment $\hbar/2$.

Following the hypothesis of Uhlenbeck and Goudsmit (1925), the own mechanical moment, assigned to an electron of the value $\hbar/2$, was called the electron spin.

Thus, the following (suitable for matching (1.4) with (1.3)!) spin magnetic moment, corresponding to the electron spin of the value $\hbar/2$,

$$\mu_{e,spin} = -\frac{e\hbar}{2m_e c}, \tag{1.5}$$

was subjectively attributed to the electron.

In this way, the "lost half" of μ_{orb} in the theoretically obtained ratio (1.4) was allegedly "found“: $\mu_{orb} = \mu_{orb,th} + \mu_{e,spin} = \mu_{orb,\exp}$.

Ultimately, having decided that the problem was solved, the invented spin concept was adopted in physics.

Subsequently, the absolute value of the "spin" magnetic moment of the electron was taken as the unit of the elementary magnetic moment under the name the Bohr magneton, μ_B:

$$\mu_B \equiv \left|\mu_{e,spin}\right| = \left|\mu_{orb,th}\right| = \frac{e\hbar}{2m_e c} \tag{1.6}$$

Thus, introducing the above postulate about the spin of the electron and with the help of a frank fitting of the magnitude of the spin (exactly equal to $\hbar/2$), physicists compensated in this way the corresponding lost half of the orbital magnetic moment in Eq. (1.4).

As a result they have come to the desired gyromagnetic ratio, coinciding with the ratio (1.3) obtained from the experiment:

$$\frac{\mu_{orb}}{\hbar} = \frac{\mu_{orb,th} + \mu_{e,spin}}{\hbar} = \frac{\mu_{orb,\exp}}{\hbar} = -\frac{e}{m_e c} \tag{1.7}$$

We return to the relation (1.4), derived by theorists, which contradicts the experimental (1.3) due to the presence of the number 2 in the denominator of the formula for $\mu_{orb,th}$ (1.6):

$$\mu_{orb,th} = \frac{e\hbar}{2m_e c} = \frac{\upsilon_0}{2c} e r_0 \,. \qquad (1.8)$$

I'll show where a blunder was committed.

Calculation of the orbital magnetic moment of an electron in an atom was carried out (as described in the literature, including textbooks on physics) according to a simple formula,

$$\mu_{orb} = \frac{I}{c} S \qquad (1.9)$$

which determines the magnetic moment of a closed electric circuit, where S is the area of the orbit, c is the speed of light, and I is the mean value of the circular current.

Following the definition of the current used in electrical engineering as a flow of electric charge ("electron liquid") in a conductor, the average value of the electric current I produced by an electron moving in orbit was determined by the formula

$$I = \frac{e}{T_{orb}} \qquad (1.10)$$

where T_{orb} is the period of revolution of an electron (with charge e) along the orbit.

Thus, on the basis of (1.9) and (1.10), physicists have come to the expression (erroneous, as we found out):

$$\mu_{orb,theor} = \frac{I}{c} S = \frac{1}{c}\left(\frac{e}{T_{orb}}\right) S = \frac{1}{c}\left(\frac{e\upsilon_0}{2\pi r_0}\right)\pi r_0^2 = \frac{e\hbar}{2m_e c} \qquad (1.11)$$

Question: where should we look for the error made in (1.11)? The answer is obvious, in the average value of the electric current I (1.10) used in (1.11).

2. Electric current *I* generated by an orbiting electron.

Physicists could and should have verified carefully the suitability of the equation (1.10) $I = e / T_{orb}$ (for a current generated by a single electron moving in an orbit), following, as they believed, from the general definition of the current, expressed by Eq. $I = \Delta q / \Delta t$. However, being absolutely confident and in no way doubting Eq. (1.10), they did not verify it, unfortunately. We have filled this gap.

Consider. What is the true average value of the current I created by a discrete (single) elementary charge e moving along a closed trajectory?

In a general case, the transfer of a charge e of an electron through any cross section S along any trajectory is accompanied by its disappearance from one side (-*e*, point A) of an arbitrary cross section and the appearance on the other side (+*e*, point B), as shown in Fig. 1. So, the disappearance of the charge on the left side of the cross section means a decrease in charge to the left of +*e* to zero, i. e., by an amount -*e*.

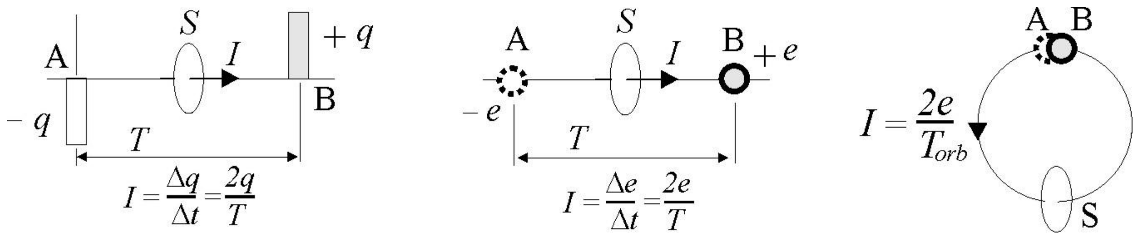


Fig. 1. The average current I created by a charge q or e moving along a closed trajectory.

And the appearance of a charge on the right side of the section means an increase in charge to the right of zero to +*e*, i. e., on the value of +*e*.

Thus, during the time T, the total change in charge is $\Delta q = +e - (-e) = 2e$. Hence, the average rate of change of the charge (current I) during the time T is

$$I = \frac{\Delta q}{\Delta t} = \frac{e-(-e)}{T} = \frac{2e}{T} \tag{1.12}$$

And in the case of a circular orbit, when the points A and B coincide, an electron having a charge e passes through the cross section S with an average speed

$$I = \frac{2e}{T_{orb}} \tag{1.13}$$

where T_{orb} is the period of revolution of an electron in a circular orbit.

Generally, the transfer of any property (a parameter of exchange p) of some object (Fig. 2) is characterized by the average rate of exchange I, determined by the expression $\langle I \rangle = 2p/T$.

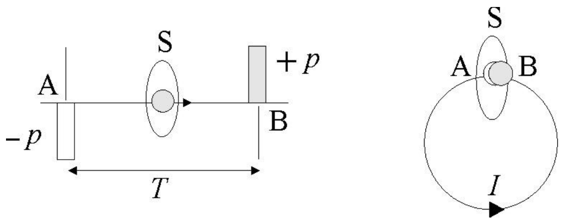
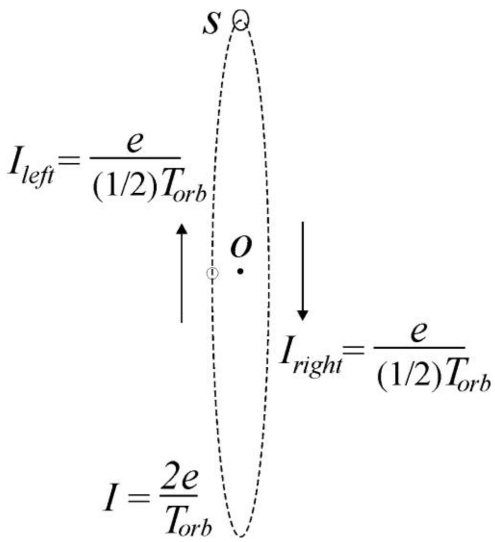


Fig. 2. Transfer of a property p (parameter of exchange) of some object.



We can also come to formula (1.13) without violating the generally accepted definition of the concept of current intensity by the following way. Let us transform the circular orbit into elliptical, as shown in Fig. 3. We get a two-wire closed loop.

Fig. 3. An average current in a two-wire closed loop generated by a moving charge e.

An electron, moving along the closed circuit (during one full revolution T_{orb}) passes in the immediate vicinity of the point "O" two times: first, moving up (average current on the left half of the trajectory $I_{left} = e/(1/2)T_{orb}$), and then moving down (the average current on the right half of the trajectory $I_{right} = e/(1/2)T_{orb}$). Thus, the electron two times creates a transverse (vortex) magnetic field at this point: first, passing along the left, and then along the right side of the trajectory from its centre "O".

With this, the conventional formula, which follows from the definition of the mean value of the current intensity $I=\Delta q/\Delta t$, adopted in physics, is not violated. Both from the left and right sides, and consequently, along the entire closed circuit, the average current is the same; it is equal to:

$$I = I_{left} = I_{right} = \frac{2e}{T_{orb}} \tag{1.14}$$

An electron, like any other elementary particle, manifests duality of behaviour, both particles and waves. Therefore, we should derive the formula for the mean value of the current also for the case of the wave motion of an electron. To do this, firstly, it is necessary to determine the relationship between the period of revolution T_{orb} and the wave period T_0.

Consider a one-dimensional case. From the well-known solution of the wave equation for a string of length l fixed at both ends, it follows that only one half-wave of the fundamental tone is placed at its full length, i. e., $l = \lambda_1/2$.

If we connect the ends of the string together, then a circle with a length of $l = 2\pi r_0$ with one node is formed. As a result, we arrive at the equality:

$$2\pi r_0 = l = \frac{\lambda_1}{2} = \frac{\upsilon_0 T_0}{2} \qquad \mapsto \qquad T_0 = \frac{4\pi r_0}{\upsilon_0} = 2T_{orb} \tag{1.15}$$

where υ_0 is the wave speed in the string, T_0 is the wave period, T_{orb} is the period of revolution.

In the simplest three-dimensional case of solving the wave equation for a spherical field [3], we arrive at the same equality (1.15): only one half-wave ($l_1/2$) of the fundamental tone is placed on the Bohr orbit (of the length $2\pi r_0$) and the electron is in the node of the wave.

Thus, the wave period T_0 of the fundamental tone on the wave surface of radius r_0 is equal to the time of two full revolutions along the orbit: i. e., equal to $2T_{orb}$,

$$T_0 = 2\left(\frac{2\pi r_0}{\upsilon_0}\right) = 2T_{orb} \tag{1.16}$$

The average value of electrical current, as a harmonic quantity, is determined by the known formulas:

$$I = \frac{2}{iT}\int_0^{T/2} I_m e^{i\omega t} dt = \frac{2}{\pi} I_m \qquad \text{or} \qquad I = \frac{1}{2\pi i}\int_0^{2\pi} I_m e^{i\phi/2} d\phi = \frac{2}{\pi} I_m \tag{1.17}$$

The amplitude of the elementary current I_m entering the expression (1.17) is

$$I_m = \left(\frac{dq}{dt}\right)_m = \omega_0 e = \frac{2\pi e}{T_0} \qquad (1.18)$$

where ω_0 is the frequency of the fundamental tone of the electron orbit. Substituting (1.18) into (1.17), we obtain

$$I = 4e / T_0 \qquad (1.19)$$

or, since $T_0 = 2T_{orb}$ (see (1.16)),

$$I = 2e / T_{orb} \qquad (1.20)$$

The true value of the average current (1.20) is twice the value $I = e / T_{orb}$ (1.10) used by theorists in formula (1.9) when calculating the orbital magnetic moment of the electron μ_{orb} at describing the Einstein-de Haas effect.

Surprisingly, so far almost for a century, no one paid attention to the formula of the average value of electric current *I* produced by an orbiting electron [3, 4]. Didn't see the gross error contained in it?

3. The electron orbital magnetic moment and the gyromagnetic ratio.

Thus, the error was found. Substituting the true value of the average current (1.20) into the formula (1.9), we arrive at the true value of the orbital magnetic moment of the electron:

$$\mu_{orb} = \frac{I}{c} S = \frac{1}{c}\left(\frac{2e}{T_{orb}}\right)\pi r_0^2 = \frac{\upsilon_0}{c} e r_0 \qquad \text{or} \qquad \mu_{orb} = \frac{e\hbar}{m_e c} \qquad (1.21)$$

Hence, the true ratio of the orbital magnetic moment of the electron μ_{orb} (1.21) to its mechanical moment $\hbar = m_e \upsilon_0 r_0$ (orbital angular momentum), taking into account the sign (the opposite direction of the moments), is equal to

$$\frac{\mu_{orb}}{\hbar} = -\frac{\upsilon_0 e r_0}{c m_e \upsilon_0 r_0} = -\frac{e}{m_e c} \qquad (1.22)$$

The obtained ratio of the moments (1.22) coincides with the ratio of the moments (gyromagnetic ratio) (1.3), which was observed experimentally in the Einstein-de Haas experiments and in Barnett's experiments.

By the way, the true value of the own magnetic moment of an electron is negligibly small in comparison with the value assigned to it subjectively in half of the orbital magnetic moment. What is its specific value and how it was calculated can be found in [5].

Here is an interesting example for a greater understanding of the degree of meaninglessness of introducing the electron spin $\hbar/2$.

For the Earth, the own ("spin") and orbital moments of momentum are equal, respectively, to:

$$L_{own,Eth} = J \cdot \omega = (2/5) M R_{Eth}^2 \omega = 7.07 \cdot 10^{33}\ kg \cdot m^2 \cdot s^{-1}$$

and

$$L_{orb,Eth} = MVR_{orb,Eth} = 1.12 \cdot 10^{39}\, kg \cdot m^2 \cdot s^{-1}$$

The ratio of the above moments is

$$L_{own,Eth} / L_{orb,Eth} = 6.3 \cdot 10^{-6}$$

Imagine that the own moment of momentum of our Earth has become equal to half of its orbital moment of momentum, i. e.,

$$L_{own,Eth} / L_{orb,Eth} = 1/2$$

The period of revolution T_{own} of the Earth in this case would be about

$$T_{own} = 4\pi \cdot J / L_{orb} \approx 1.091 s$$

(as against $T_{own,Eth} = 86400\, s$ that is in reality).

The Earth will not be able to withstand such a huge own moment of momentum ("spin") and will be destroyed.

Existence of an electron (regardless of a permissible size that would have been attributed to it) with "spin" equal to $\hbar/2$ is also (like Earth with $L_{own} = L_{orb} / 2$) impossible.

Estimated in the Wave Model [5], own (spin) magnetic moment of an electron is insignificant,

$$\mu_{spin} = 5.609964 \cdot 10^{-29}\, J \cdot T^{-1}$$

as against orbital one,

$$\mu_{orb} = 1.855877461 \cdot 10^{-23}\, J \cdot T^{-1}$$

Thus,

$$\mu_{spin} / \mu_{orb} = 3.0 \cdot 10^{-6}$$

As we can see, the ratios of the above moments (own, "spin", to orbital) for both the orbiting electron and for the Earth are insignificant, have the same order of magnitude, 10^{-6}.

All details about the issues discussed in this report can be found in the Lectures of the author on the Wave Model [6].

Part 2. Subsequent concepts

1. G-factor and anomaly α_e of the electron spin magnetic moment.

A mistake in two times, made in the derivation of the orbital magnetic moment of the electron $\mu_{orb,th}$, led to a whole series of postulated concepts. One of them is the concept of g-factor.

According to the original definition, the g-factor is a multiplier, which connects the gyromagnetic ratio of the particle γ obtained experimentally with the value of the gyromagnetic ratio γ_0 obtained theoretically (erroneous, as we have shown), following (as it was thought) the classical theory:

$$\gamma = g\gamma_0 \tag{2.1}$$

The gyromagnetic ratio γ for an electron, following from the experiment (Einstein-de Haas, Barnett and others) [7], is

$$\gamma = \frac{\mu_{orb,\exp}}{\hbar} = -\frac{e}{m_e c} \tag{2.2}$$

The theoretical value γ_0 , obtained in describing this effect, is twice smaller, i. e., equal to

$$\gamma_0 = \frac{\mu_{orb,th}}{\hbar} = -\frac{e}{2m_e c} \tag{2.3}$$

Thus, as follows from the above definition, the g-factor for an electron is equal to two:

$$g = 2 \tag{2.4}$$

According to the definition, accepted in modern physics, the so-called general g-factor is a factor connecting the gyromagnetic ratio of a particle γ with the classical value of a gyromagnetic ratio γ_0:

$$\gamma = g\gamma_0$$

As we see, the mistakenly calculated value $\gamma_0 = \left(\frac{1}{2}\right)\frac{q}{mc}$ (2.3) is considered in physics as a matter of course the "classical value" of the gyromagnetic ratio. Obviously, this means a lack of understanding of the fallacy of the relation (2.3). The g-factor is, in essence, an indicator of the mistake, its degree, made at the theoretical derivation of the orbital magnetic moment of an electron, and nothing more. Hence, the assignment (by ignorance) a certain physical meaning ("classical value") to the relation (2.3) is unreasonable and erroneous.

The experimental value of the magnetic moment of an electron in the Bohr orbit, which was determined more accurately over time, $\mu_{orb,\exp}^{updated}$, slightly differs from the value obtained in the initial experiments,

$$\mu_{orb,\exp}^{updated} > \mu_{orb,\exp} = -\frac{e}{m_e c}\hbar = -\frac{\upsilon_0}{c} e r_0 \tag{2.5}$$

where $\hbar = m_e \upsilon_0 r_0$.

This small deviation (increase) was called an "anomaly".

Recall, the total magnetic moment of the electron (μ_{orb}) in the Bohr orbit consists, as was accepted in physics, (in half) of the orbital magnetic moment (erroneously calculated, as we have shown [7, 8]) ,

$$\mu_{orb,th} = \tfrac{1}{2}\mu_{orb,\exp} , \tag{2.6}$$

and (in half) of the own ("spin") magnetic moment (attributed to the electron) also equal to $\mu_{orb,th}$,

$$\mu_{e,spin} = \mu_{orb,th} = \tfrac{1}{2}\mu_{orb,\exp} \tag{2.7}$$

The term $\mu_{e,spin}$ is equal to the lost half of the orbital magnetic moment μ_{orb}. It was introduced to compensate for the mistake in calculations of μ_{orb} in two times. Thus, it was accepted that

$$\mu_{orb} = \mu_{orb,th} + \mu_{e,spin} = \mu_{orb,\exp} = -\frac{e}{m_e c}\hbar \qquad (2.8)$$

Because of the "anomaly“, $g_e > 2$.

In quantum mechanics (QM), probabilistic in nature, which replaced the theory of the Rutherford-Bohr atom, there is no concept of orbital motion. Therefore, it was suggested (and further accepted) that the “anomaly” concerns the spin component ($\mu_{e,spin}$) of μ_{orb}: the property inherent, as believed, in a free electron.

For convenience, in physics it was customary to express the "anomalous" magnetic moment of a free electron using the parameter α_e (called “anomaly”) defined by the following equality:

$$\alpha_e = \frac{g_e - 2}{2} \qquad (2.9)$$

Taking into account (2.9) and the value of the intrinsic angular momentum of the electron (spin), equal, as was accepted, to half of the orbital moment of momentum, $\hbar/2 = \left(1/2\right) m_e \upsilon_0 r_0$, the expression for the spin magnetic moment of the electron is given in the following form:

$$\mu_{e,spin} = -g_e \frac{e}{2m_e c}\left(\frac{\hbar}{2}\right) = -\frac{g_e}{2}\mu_B = -\mu_B(1+\alpha_e) \qquad (2.10)$$

What can be the cause of disturbances of a free (as believed) electron resulting in the “anomaly” α_e of its own (spin) magnetic moment?

2. Virtual particles

Influence of intra-atomic dynamics of constituent particles (nucleons and electrons) each separately and bonds between them were excluded from possible causes, since this is not a feature of the behaviour inherent in the atom, according to the existing concept about its structure.

An atom was considered as the centrally symmetric system, consisting of a tiny superdense nucleus (containing protons and neutrons) and electrons, moving around (indefinitely, how), obeying the probabilistic laws of quantum mechanics. For example, the simplest nucleus of the hydrogen atom, a proton, was considered in the form of a rigid compact static formation, similar to a solid spherical micro object of giant density, on average about $4\times10^{14}\ g\cdot cm^{-3}$, and 10^5 times smaller in size than the atom.

Despite the absurdity of the existing model of the atom, it was/is not questioned by official physics and no attempts were/are made to revise it. Physicists-theorists have suggested that the perturbing effect on a free electron, leading to an “anomaly” of its own (“spin”) magnetic moment, is caused by the influence of virtual particles.

In accordance with the postulate on "virtual" particles, any ordinary particle continuously emits and absorbs virtual particles of various types. And the interaction between them is described in terms of the exchange of virtual particles. In particular, the electromagnetic repulsion or attraction between charged particles is considering as due to the exchange of many virtual photons between the charges.

The physical state of vacuum is also associated with continuously generating and absorbing virtual particles in the field-space of the vacuum. The process of the appearance and disappearance of particles lasts so short time interval (about 10^{-24} s), so that no detectors can find such particles in principle, hence the name ─ virtual (imaginary, that is, in fact, unreal) [9].

It was accepted to consider that an electron emits and absorbs virtual photons, which change the effective electron mass. As a result, this affects the intrinsic ("spin") magnetic moment of the electron and leads to its "anomaly".

A phenomenon called the Lamb shift [10] (the shift of the s- and p-levels) is considered also, as it is commonly believed, as the result of the interaction between the electron moving along the orbit and the virtual particles, which are "swarming" in the surrounding vacuum.

Due to quantum fluctuations of the zero field of the vacuum, continuously generating and absorbing virtual particles, the orbital motion of an electron in an atom is subject to additional chaotic motion.

Thus, in order to explain the small but noticeable perturbations in the motion of an electron, resulting in the "anomalous" magnetic moment of the orbiting electron and the hyperfine structure of the energy levels of hydrogen and deuterium (the Lamb shift), the postulate on virtual particles was invented.

The latter was accepted as one of the fundamental postulates in the developing quantum field theory. Currently, a virtual particle is defined in physics as a transient fluctuation that exhibits some of the characteristics of an ordinary particle, but whose existence is limited by the uncertainty principle.

3. Dirac equation

Thus, after the introduction of the postulate on the electron spin $\hbar/2$, a whole series of concepts, related to the spin, was invented and introduced into physics. So, we have:

"*Electron spin*"
"*Electron spin* g-*factor*"
"*Anomaly*" of the electron spin magnetic moment,
"*Classical value*" for the gyromagnetic ratio,
"*General* g-*factor*" for elementary particles,
"*Virtual particles*"

In 1928, Dirac took the next steps in the same direction. Knowing the problems faced physics at that time, combining quantum mechanics and relativity, Dirac tried to rebuild the Schrödinger equation (invented in 1926) in such a way that the existence of the electron spin would follow from its solutions.

As a result, the so-called relativistic generalization of the Schrödinger equation, the Dirac equation, appeared in physics. Recall, Schrodinger's equation is the main equation of quantum mechanics (QM), and is one of its six basic postulates.

Schrodinger's equation (QM postulate)		*Dirac's equation* (QED postulate)
(2.11) $i\hbar\dfrac{\partial\Psi}{\partial t}=\hat{H}\Psi$	$\Leftarrow$ Compact forms $\Rightarrow$	$i\hbar\dfrac{\partial\Psi}{\partial t}=\hat{H}\Psi$ (2.13)
(2.12) $\hat{H}=\dfrac{1}{2m}\hat{\mathbf{p}}^2+U(r,t)$		$\hat{H}=c\boldsymbol{\alpha}\hat{\mathbf{p}}+mc^2\beta$ (2.14)

We see that Dirac and Schrodinger equations have the same compact form, the difference in Hamilton operators. For particles moving in an electromagnetic field, the corresponding Hamiltonians are representing as follows:

(2.15) $\hat{H}=\dfrac{1}{2m}\left(\mathbf{p}-\dfrac{e}{c}\mathbf{A}\right)^2+e\varphi$	$\hat{H}=c\boldsymbol{\alpha}\left(\mathbf{p}-\dfrac{e}{c}\mathbf{A}\right)+e\varphi+mc^2\beta$ (2.16)

where **p** is the operator of a generalized momentum of a particle, **A** and φ are vector and scalar potentials, *e* – particle charge, **α** – vector operator, β – operator not contained coordinates.

So, combining quantum mechanics and relativity, Dirac generalized the Schrödinger equation by changing its Hamiltonian. He began to rebuild the Hamiltonian in the equation in such a way that between $\hat{\boldsymbol{H}}$ and operators of momentum the same relation will remain that exists between energy and momentum in the theory of relativity, that is,

$$\hat{H}^2=c^2(\hat{p}_x^2+\hat{p}_y^2+\hat{p}_z^2)+m^2c^4 \qquad (2.17)$$

This requirement ultimately led to the introduction of special operators, **α** and β, and the operator $\hat{\boldsymbol{H}}$ took the form (2.14).

4. Dirac's solutions

Solving the obtained equation, Dirac came, in result, to the absurd conclusion about the existence of negative kinetic energy. This led to very serious consequences for physics, one of which is the Electron Theory of Solids (the latter is subject to special consideration).

Relativistic expression for energy,

$$E^2=c^2p^2+m_0^2c^4 \qquad (2.18)$$

(taken into account in the Hamiltonian of the Dirac equation), admits two equitable solutions:

$$E=\pm\sqrt{c^2p^2+m_0^2c^4} \qquad (2.19)$$

Their difference, at p=0, formally defines the minimal difference of energies equal to $2m_0c^2$ (Fig. 4):

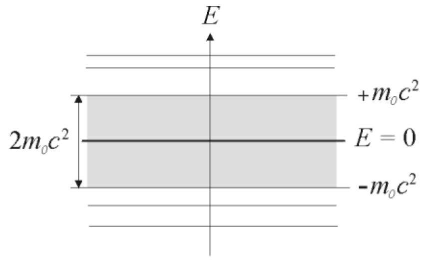


Fig. 4. The formal levels of kinetic energy, divided by the interval of $2m_0c^2$.

According to relativity theory, only the relative motion exists in nature, where the rest is excluded, accordingly, the potential energy is impossible. This peculiarity of Einstein's relativism one should regard as the coarsest distortion of the real nature of any processes.

Keep in mind that according to dialectics [11], which represents a synthesis of the best achievements of both materialism and idealism, and is the ground for understanding the material-ideal essence of the world, the motion is absolute-relative.

According to Einstein, solution (2.19) determines the kinetic energy. Therefore, Dirac interpreted the energy with a minus sign, as negative kinetic energy. He supposed, further, that all states with the negative energy are occupied with electrons. He put forward this supposition because of that simple reason that he plainly did not know in earnest, what one should make with the negative energy.

However, why should negative energies be inherent only to electrons in the entire Universe? There is not a single-valued answer to this question, because such a version of filling the energies is strikingly primitive. But, as Dirac has assumed, this model has excluded the transition of particles in the states with the negative energy, which were already occupied.

From the formal point of view, when there is no clear understanding of the problem in question, interpretation of the negative sign of energies has required introducing the negative mass or the charge with the opposite sign. Such an object became to be regarded as a "*hole*" in the space of matter...

Introducing the equations in any theory, it is not so easy to guess beforehand what signs of kinetic and potential energies will arise from their solutions. One should clearly understand that any algebraic or differential equation is indifferent to our views on either sign of parameters, which originates from the equation. Unknowing the philosophy of signs, Dirac made the simplest and wrong decision.

Dirac also stated that electron spin $\hbar/2$, non-existent, as we have convincingly shown (discussed in Part 1), allegedly follows from solutions of his equation. Since then, it is commonly believed that the electron spin $\hbar/2$, previously introduced subjectively to a free (unbounded) electron at the description of the Einstein-de Haas effect, really follows directly from Dirac's equation.

Thus, the problem associated with the lost half of the angular momentum $\hbar/2$, which led to the above conclusion, arose, naturally, when solving the Dirac equation. Let's see how it was performed.

One of the main faults of the Dirac theory is the sad fact that binary potential-kinetic nature of physical processes and, hence, the presence of binary parameters characterizing their course, were not taken into account. Hence, potential and kinetic energy were interpreted by Dirac erroneously, as positive and negative kinetic energy (that seriously affected the development of physics).

Further more. As a consequence, Dirac came to an erroneous result also in the next case. When he composed the operator of moment of momentum $\hat{\boldsymbol{L}} = [\hat{\boldsymbol{r}}\hat{\boldsymbol{p}}]$, the binary potential-kinetic nature of the particle speed $\hat{\upsilon} = d\hat{\Psi}/dt$, caused by the potential-kinetic nature of the displacement $\hat{\Psi} = \Psi_p + i\Psi_k$, has not been taken into account in the operator of momentum of a particle, $\hat{\boldsymbol{p}} = m\hat{\upsilon}$.

Therefore, since the $\hat{\boldsymbol{p}}$ operator did not contain the potential (normal) component υ_p of the operator of velocity vector $\boldsymbol{\upsilon}$, the operator of angular momentum $\hat{\boldsymbol{L}}$ was, naturally, incomplete. For this reason, of course, the incomplete operator $\hat{\boldsymbol{L}}$ did not commute with the Hamiltonian $\hat{\boldsymbol{H}}$ (2.14), what really happened, that is,

$$\hat{\boldsymbol{H}}\hat{\boldsymbol{L}} - \hat{\boldsymbol{L}}\hat{\boldsymbol{H}} \neq 0 \qquad (2.20)$$

This means that moment of momentum $\boldsymbol{L} = \boldsymbol{r} \times m\upsilon$ is not an integral of motion and is not preserved. In other words, the law of conservation of angular momentum for such a moment is not respected.

It would be naturally to turn attention to the velocity vector $\boldsymbol{\upsilon}$ and its components in the angular momentum, since all projections of the latter are testing on commuting with the Hamiltonian. However, to find a way out of the situation, Dirac went the other way, introducing a new operator $\hat{\boldsymbol{J}} = \hat{\boldsymbol{L}} + \hat{\boldsymbol{s}}$, where $\hat{\boldsymbol{s}}$ is some unknown operator, additional to the first one. Note that to that time Dirac knew about the hypothesis about the electron spin $\hbar/2$, put forwarded in 1925 by Uhlenbeck and Goudsmit to describe Einstein-de Haas effect.

Searching the condition, at which the new operator $\hat{\boldsymbol{J}}$ will be commuted with Hamiltonian, Dirac found that eigenvalues of the operator $\hat{\boldsymbol{s}}^2 = \hat{s}_x^2 + \hat{s}_y^2 + \hat{s}_z^2$ have the form:

$$\frac{3}{4}\hbar^2 \qquad (2.21)$$

From (2.21) it follows that the value of the additional (to the incomplete $\boldsymbol{L}$) moment of momentum of a particle (its projection in a certain direction) is equal to $\hbar/2$.

The obtained value $\hbar/2$ represents half the orbital moment of momentum of the electron in the first Bohr orbit, which is equal to

$$\hbar = m_e\upsilon_0 r_0.$$

Since in a spherical field $\upsilon_n r_n$ = const, for a particle with mass m moving with speed υ, the angular momentum is

$$L = m\upsilon r = m\upsilon_0 r_0$$

Although there were no any convincing arguments to assert that the value $\hbar/2$ relates to the hypothetical electron spin (non-existing, as we now know), nevertheless, Dirac associated the obtained value of $\hbar/2$ just with the hypothetical proper moment of momentum of an electron – spin – thereby confirming the above hypothesis. This decision was unfounded. Dirac took wishful thinking.

Subsequent calculations showed erroneousness of this decision. Namely, calculations have shown that electron spin with value $\hbar/2$, subjectively introduced as additional mechanical parameter to compensate the lost half of the angular momentum (mechanical parameter), and cannot be identified in the classical sense, as a parameter associated with mechanical rotation of the electron along its axis.

An electron cannot withstand such a giant proper angular momentum (if the latter could really exist) as $\hbar/2$. Equal to half the orbital angular momentum, own moment of $\hbar/2$ will destroy the electron, regardless of size ascribed to it.

However, physicists of that time liked the idea of the electron spin so much that they did not want to part with it and invented a new physical meaning for it.

So, by accepted definition, electron spin became considered as some inner quantum property ("intrinsic", non-mechanical) inherent in a particle, additionally to such basic properties as mass and charge.

Eigenvalues of the operator (2.21) $\hat{\boldsymbol{s}}^2 = \hat{s}_x^2 + \hat{s}_y^2 + \hat{s}_z^2$ began to represent in the form:

$$\hbar^2 s(s+1) \qquad (2.22)$$

where s=1/2 was called an intrinsic or spin quantum number of a particle. Now it is this number (1/2) that is usually called the spin of the particle …

5. Comments on Dirac's solution

Surprisingly, as time has shown, no one thought about the correctness of the accepted decision. The subjective introduction of a new fictional notion showed a complete lack of common sense logic in the hypothetical theoretical constructions of physicists of that time.

The fictional intrinsic "quantum" parameter (non-material, intangible), which was attributed to the electron cannot affect the value of the angular (rotational) momentum $\boldsymbol{L}$ of the orbiting particle regardless of the magnitude attributed to such a quantum parameter.

Therefore, considering the spin actually as a kind of indefinite inner property (the definition a "quantum property" doesn't clarify anything), it is pointless to add it (a fictional parameter not related to real spinning) to the real mechanical angular momentum $\boldsymbol{L}$, which characterizes the motion of a particle as a whole and depends on the real parameters such as distance r, mass m and speed υ of the particle.

Obviously, and this follows from our research, the value of $\hbar/2$ obtained by Dirac is that half of the orbital moment of momentum of an electron, which by ignorance was not taken into account in the calculations. We will show this. Note that the lost of half of the orbital magnetic moment of the electron, occurred in the calculations that we talked about in Part 1, has a different reason.

At a circular motion, in a moving coordinate system with unit basis vectors, tangent $\boldsymbol{\tau}$ and normal $\mathbf{n}$ (Fig. 5), potential and kinetic speeds are related by the following way (details are in [12]):

$$\hat{\mathbf{v}} = \hat{\mathbf{v}}_k + \hat{\mathbf{v}}_p = \upsilon\boldsymbol{\tau} + i\upsilon\mathbf{n} \tag{2.23}$$

Scalar form of the speed (2.23) in the mobile basis is

$$\hat{\upsilon} = \upsilon_k + \upsilon_p = \upsilon + i\upsilon \tag{2.24}$$

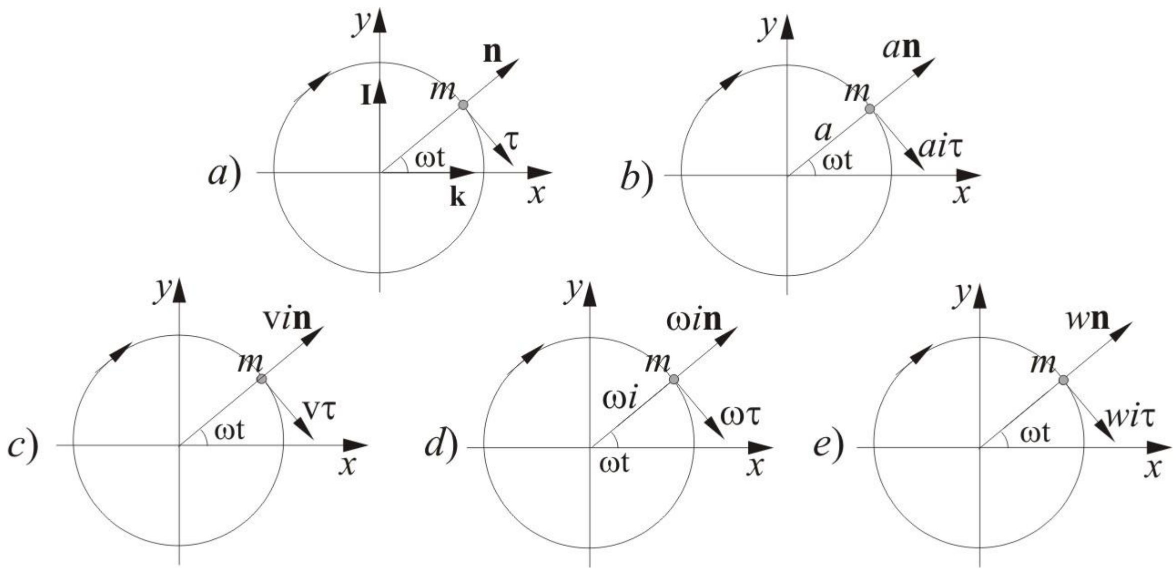


Fig. 5. Kinematics of motion-rest along a circle [12]:

a) units vectors, $\boldsymbol{k}$ and $\boldsymbol{I}$ - in motionless basis, $\boldsymbol{\tau}$ and $\mathbf{n}$ - in mobile basis;
b) $\mathbf{r}_p = a\mathbf{n}$ and $\mathbf{r}_k = ia\boldsymbol{\tau}$ are potential and kinetic radii-vectors of motion;
c) $\mathbf{v}_p = i\omega a\mathbf{n} = i\mathrm{v}\mathbf{n}$ and $\mathbf{v}_k = \omega a\boldsymbol{\tau} = \mathrm{v}\boldsymbol{\tau}$ are potential and kinetic velocities;
d) $\boldsymbol{\omega}_p = i\omega\mathbf{n}$ and $\boldsymbol{\omega}_k = \omega\boldsymbol{\tau}$ are potential and kinetic angular velocities;
e) $\mathbf{w}_p = \omega^2\mathbf{r}_p = \omega^2 a\mathbf{n} = w\mathbf{n}$ and $\mathbf{w}_k = \omega^2\mathbf{r}_k = i\omega^2 a\boldsymbol{\tau} = iw\boldsymbol{\tau}$
are potential and kinetic accelerations.

And the potential and kinetic speeds are related as follows:

$$\upsilon_p = -i\upsilon_k \tag{2.25}$$

Accordingly, an operator corresponding to the potential speed is equal to

$$\hat{\boldsymbol{p}}_p = -i\hat{\boldsymbol{p}}_k \tag{2.26}$$

Taking into account the latter, that is, the binary nature of the speed and, consequently, momentum (2.26), the operator of moment of momentum $\hat{\boldsymbol{L}}$ takes the form,

$$\hat{\boldsymbol{L}} = \hat{\boldsymbol{L}}_k + \hat{\boldsymbol{L}}_p \tag{2.27}$$

It commutes with the Hamiltonian (2.14) $\hat{H} = c\boldsymbol{\alpha}\hat{\mathbf{p}} + mc^2\beta$, that is,

$$\hat{\boldsymbol{H}}\hat{\boldsymbol{L}} - \hat{\boldsymbol{L}}\hat{\boldsymbol{H}} = 0 \tag{2.28}$$

This means that moment of momentum $L = L_k + L_p$ is an integral of motion and is preserved. In other words, the law of conservation of angular momentum for such a moment is respected. Thus, the $\hat{\boldsymbol{L}}$ operator, which takes into account the binary nature of the parameters characterizing the circular motion, commutes with the total energy operator $\hat{\boldsymbol{H}}$ of the system.

Finally, overcoming emerging issues by inventing new parameters, what have physicists come to as a result? As we see, based on the concepts discussed above (in Parts 1 and 2), the following ultimately happened: physicists have created quantum field theory – Quantum Electrodynamics (QED). Dirac equation became its basic postulate.

Dirac equation is based on the Schrodinger equation (SE). The latter is a fictional equation – an abstract-mathematical postulate. And, as follows from our research, its "solutions", to put it mildly, are erroneous, that is, the Schrödinger equation is inadequate to reality. This has been convincingly proven (most physicists probably already know about this, see, for example, [13-17]). Accordingly, Dirac equation is as well inadequate to reality. Thus, Dirac's equation became yet another abstract-mathematical creation in a chain of doubtful postulated concepts accepted in physics, along with others discussed here.

However, Dirac's erroneous ideas gave birth to the theory of the electromagnetic vacuum, perhaps the most primitive mechanical theory of the field of matter-space-time. This theory formally led to the conclusion that there are electrons with positive charges, that is, positrons.

The world, as a system of oppositions, does not require equations for confirmation of the fact that oppositions really exist. But, unfortunately, the discovery of positrons was regarded as a triumph of Dirac's theory, although, his erroneous interpretation of the negative sign of energy, in essence, had no relation to the positron.

Part 3. Consequences of accepted concepts

1. Fitting method

Thus, as we found out, the basis of QED, including the Dirac equation, is very doubtful, inadequate. What basis - such consequences. For this reason, solving problems arising in physics by Dirac's equation is impossible without an elementary mathematical fitting.

First, the fitting method was applied in calculating the "anomalous" magnetic moment of the electron and the Lamb shift. Since then, with increasing accuracy of the values obtained in this way for the "anomaly" and the Lamb shift, using the mythical postulates, for over 60 years, modern quantum electrodynamics (QED) has been developed.

The method of fitting continues to this day in connection with obtaining more accurate experimental data, and thanks to advances in computer technology, the advent of supercomputers.

In quantum theory of the atom there is no concept of a trajectory (motion of electrons) or an orbit. Therefore, in QED, the calculation of the perturbation value ("anomaly") is performed with respect to the spin magnetic moment of the electron (2.10). However, as we have shown, the latter is a fictitious parameter ascribed to an electron subjectively (in addition to its real parameters, which are mass and charge). The presence of spin magnetic moment of the electron is not confirmed experimentally. There is no information about experiments that have ever been conducted or planned to be carried out on free electrons, not connected with their atoms.

Adhering to the postulate about virtual particles, the derivation of the "anomaly" of the spin magnetic moment was carried out by the fit method and at the cost of enormous efforts for many decades by QED theorists from all over the world.

2. QED equation for the «anomalous» electron magnetic moment

How deeply the theory of QED advanced, and to what extent of the perfection the mathematical fitting of the data to the experiment has achieved, one can see from the extremely complicated and cumbersome resultant formula (3.1) (see below) derived for the anomaly α_e (2.9) [18].

In fully expanded form the QED calculation equation for the anomaly α_e (2.9), entering in the expression $\mu_{e,spin} = -\mu_{\mathrm{B}}(1+\alpha_e)$ (2.10), is extremely cumbersome because of huge mathematical expressions for the coefficients in each of the terms of the equation. Therefore, we placed here only a reduced expression for anomaly α_e, represented in the form of an expansion in powers of the fine-structure constant $\boldsymbol{\alpha}$, with the numerical values of the coefficients already calculated (the data of 2003 [18]):

$$\begin{aligned}\alpha_e = 0.5\left(\frac{\alpha}{\pi}\right) - 0.328478965579...\left(\frac{\alpha}{\pi}\right)^2 + 1.181241456...\left(\frac{\alpha}{\pi}\right)^3 - \\ -1.5098(384)\left(\frac{\alpha}{\pi}\right)^4 + 4.382(19)\times 10^{-12} = 0.0011596521535(12)\end{aligned} \qquad (3.1)$$

The alpha constant (α) (entering into (3.1)) is the fundamental constant of modern physics, called the fine-structure constant:

$$\alpha = \frac{e^2}{4\pi\varepsilon_0\hbar c}$$

$\alpha = 7.2973525664\times 10^{-3}$ (see [2014 CODATA recommended values]).

The nature of its origin still is the greatest mystery for modern physics. Most till now do not know that this problem has already been solved in the framework of WM (details in [19]). For those who will be interested in this. According to the Wave Model, α-constant is a dimensionless physical quantity that shows the scale correlation of threshold conjugate parameters, oscillatory and wave, inherent in the wave motion. For example, it characterises the ratio of speeds:

$$\alpha = \upsilon_0 / c,$$

where υ_0 — maximal oscillatory speed of the electron in a hydrogen atom (the speed in the first Bohr orbit), and c — the maximal base speed of propagation of waves generated by the pulsating wave shell of the proton (the wave speed) [20].

3. Numerical coefficients in the "anomaly" equation

Take for example, the coefficient at the fourth term $(\alpha/\pi)^4$ of the expansion (3.1); it is equal to $1.5098(384)$. It was obtained with great uncertainty in the last three signs, ± 384, and is the result of computing more than 100 huge ten-dimensional integrals.

The last small term in formula (3.1), $4.382(19)\times 10^{-12}$, takes into account the contribution of quantum chromodynamics. Therefore, earlier, for calculations, a complex system of massively-parallel computers of giant performance was used (now - supercomputers).

In fact, we are witnessing the continuing grandiose mathematical fitting, which reached the highest degree of perfection during about 70 years that passed after the first works of 1947 by H. A. Bethe [21] and T. A. Welton [22], thanks to the strenuous efforts of physicists-theorists from all over the world.

Thus, the QED formula for the "anomaly" (3.1), posted here with the coefficients already calculated for the terms of the expansion, was derived with allowance for the influence of virtual (mythical) particles. In fully expanded form with coefficients, it is extremely cumbersome. Expressions for the coefficients represent complex ten-dimensional integrals, for the calculation of which (there are hundreds of them) supercomputers are required.

The numerical value of the "anomaly" calculated by the formula (3.1) [17] is equal to

$$a_e = 1.1596521535(12)\cdot 10^{-3} \qquad (3.2)$$

Up to the 7th decimal place this value of the "anomaly" (3.2) coincides with the last value recommended for use in physics in 2016 [23].

4. Analysis of the resulting solution

The accepted values of all main parameters related with the spin concept considering here, recommended for use in physics in 2016 [23], including (3.2), are given below.

1. *Bohr magneton* $\mu_B = 927.4009994\cdot 10^{-26}\ J\cdot T^{-1}$ (3.3)
2. *Spin magnetic moment of an electron* $\mu_{e,spin} = -928.4764620\cdot 10^{-26}\ J\cdot T^{-1}$ (3.4)
3. «*Anomaly*» *of the moment* $a_e = 1.15965218091\cdot 10^{-3}$ (3.5)
4. *Electron g-factor* $g_e = 2.00231930436182$ $g_e = 2(1+\alpha_e)$ (3.6)

1. The Bohr magneton μ_B is defined in atomic physics as "*a physical constant and the natural unit for expressing the magnetic moment of an electron caused by either its orbital or spin angular momentum*". In magnitude, μ_B was taken equal to the erroneously calculated value of the orbital magnetic moment $\mu_{orb,th}$: $\mu_B = |\ \mu_{orb,th}|$.

2. The value of $\mu_{orb,th}$ was also subjectively ascribed to the spin magnetic moment of an electron $\mu_{e,spin}$. Thus, initially, $\mu_{e,spin} = \mu_{orb,th} = -\ \mu_B$.

Later, after the subsequent correction of $\mu_{e,spin}$ (taking into account the "anomaly" α_e), the updated value (3.4) became a little bigger in magnitude compared to the originally accepted value (3.3). So now, $\mu_{e,spin} = -\ \mu_B\ (1+\alpha_e)$.

3. On the value of "anomaly" α_e (3.5). Spin magnetic moment $\mu_{e,spin}$ of the accepted value (3.4) has not been confirmed experimentally, directly on free electrons not bound to atoms.

Its numerical value was determined by subtraction of $\mu_B = |\mu_{orb,th}|$ from $\mu_{orb,\exp}^{updated}$:

$$\mu_{orb,\exp}^{updated} - \mu_{\mathrm{B}} = \mu_{e,spin} \tag{3.7}$$

Further, knowing the magnitude of $\mu_{e,spin}$, from the relation

$$\alpha_e = \frac{|\mu_{e,spin}|}{\mu_{\mathrm{B}}} - 1 \tag{3.8}$$

(see Eq. (2.10)), the experimental value of the anomaly α_e was determined.

Then, to get the appropriate theoretical formula for the anomaly α_e, which should correspond with high accuracy to the experimental value α_e obtained from the above relation (3.8), the sophisticated theoretical manipulations (fitting) have began. As a result, despite the great difficulties, thanks to the enormous effort, the above formula (3.1) for anomaly α_e was ultimately devised.

As we have shown, spin magnetic moment, $\mu_{e,spin}$, attributed to an electron, of the value (3.4), is erroneously associated with a fictional internal property of a free electron. This quantity is actually that half of the μ_{orb} that was lost at the calculations.

Thus, in magnitude, the orbital magnetic moment of the electron (in the Bohr orbit) is equal to the sum of the two above moments approximately equal in value, (3.3) and (3.4), recommended for use in physics; that is, $\mu_{orb} = \mu_{orb,th} + \mu_{\mathrm{e,spin}}$, where

$$\mu_{orb,th} = -\mu_B = -927.4009994 \cdot 10^{-26}\ J \cdot T^{-1}$$

$$\mu_{e,spin} = \mu_{orb,th}(1+\alpha_e) = -928.4764620 \cdot 10^{-26}\ J \cdot T^{-1}$$

The influence of the electron's own motion (own rotation and oscillations) on the magnitude of its orbital moment is insignificant, $\alpha_e \approx 0.00116$ (3.5).

So, as we found out, $\mu_{orb,th}$ and $\mu_{e,spin}$ are two half of the orbital magnetic moment of an electron. Their sum is exactly equal to the experimentally obtained value of this moment. This discovery can be expressed by the equality:

$$\mu_{orb} = \mu_{orb,th} + \mu_{orb,th}(1+\alpha_e) = \mu_{orb,th}(2+\alpha_e) = \\ = \mu_{orb,\exp}^{updated} = -1855.8774614 \cdot 10^{-26}\ J \cdot T^{-1} \tag{3.9}$$

The first term in (3.9) is the erroneously calculated orbital magnetic moment of the electron (twice less than experimentally obtained). Its absolute value was accepted in physics as a fundamental physical constant under the name the *Bohr magneton,* $\mu_B = |\mu_{orb,th}|$ (3.3).

The second term represents the "lost" part of the orbital magnetic moment of the electron (with allowance for the "anomaly" α_e), attributed erroneously to a free electron as its internal parameter called spin magnetic moment, $\mu_{e,spin}$ (3.4).

Recall, the development of the GED theory began with an erroneous solution for the electron orbital magnetic moment in a hydrogen atom. The correct solution for μ_{orb}, to which we have come thanks to the Wave Model, is given below in Part 4.

Part 4. Solutions beyond QED

1. The Wave Model

The Wave Model (WM), which we have developed, is based on dialectics (dialectical philosophy and its logic). In accordance with the latter the Universe is the material-ideal system, where everything at all its levels, including micro and mega, is in a continuous oscillatory-wave motion and is subject to the law of rhythm. This means that all objects and phenomena in the Universe have a wave nature, accordingly, the general wave equation

$$\Delta\hat{\Psi} - \frac{1}{c^2}\frac{\partial^2\hat{\Psi}}{\partial t^2} = 0 \tag{4.1}$$

is applicable to describe them.

The above feature is accepted in the WM as an axiom and is taken into account in the description of physical phenomena, including the "anomalous" magnetic moment of an electron.

Details concerning conceptions of the WM and the unique results obtained within its two theories (Dynamic Model of elementary particles and Shell-Nodal Model of atoms) were presented, in particular in 2017, at two International Conferences on: Quantum Physics and Quantum Technology (Berlin, Germany) [24], and Physics (Brussels, Belgium) [25]. In [24, 25], there are links to videos and pdf-files of the above presentations.

Solutions of the WM (where the concept of circular orbits is inherent in the structure of atoms) directly lead to the true value (3.9) of the orbital magnetic moment μ_{orb}.

2. WM equation for the orbital magnetic moment of an electron

In the Wave Model, there are no postulated (fictional) concepts, such as the electron "spin", and so on. The so-called "anomaly" is explained in WM as the effect of intra-atomic wave processes on the orbital motion of the electron. But in any case this is not due to the influence of mystical virtual photons on the mystical spin of an electron.

So, according to the WM, insignificant perturbation ("anomaly") of the electron orbital motion in an atom is due to the wave nature and wave behaviour of the constituent particles of the atom and of the atom as a whole (which is an interconnected nucleon-electron wave system).

In the framework of the Wave Model, the formula of the orbital magnetic moment, taking into account weak perturbations ("anomaly"), is derived relatively simply and logically flawlessly [8, 26]. Here is its completely expanded form:

$$\mu_{orb,WM} = -\frac{e\upsilon_0}{c}\left[r_0 + \left(\lambdabar_e + \frac{r_0}{b'_{0,1}}\right)\sqrt{\frac{4\pi R\hbar}{m_0 c}} + r_0\frac{2\beta}{(y_{0,1}+y'_{0,1})}\sqrt{\frac{4\pi R\hbar_e}{m_e c}}\right] \qquad (4.2)$$

The orbital magnetic moment of an electron, obtained directly from this equation, is

$$\mu_{orb,WM} = -1855.877614\cdot 10^{-26}\ J\cdot T^{-1} \qquad (4.3)$$

It completely coincides in magnitude with $\mu^{updated}_{orb,\exp}$ and the total magnetic moment of the orbiting electron (3.9), when summing the two moments, μ_B (3.3) and $\mu_{e,spin}$ (3.4), which despite the fact that in modern physics characterize, by definition, other properties, nevertheless (for the reasons stated above), are two parts of one parameter characterizing the orbital motion of an electron. Really, $\mu^{updated}_{orb,\exp} = \mu_{orb,th} + \mu_{orb,th}(1+\alpha_e)$, where

$$|\mu_{orb,th}| = \mu_B \quad \text{and} \quad \mu_{orb,th}(1+\alpha_e) = \mu_{e,spin}$$

Physical parameters, components of equation (4.2), are:

$b'_{0,1}$, $y_{0,1}$, $y'_{0,1}$ – *roots* of the Bessel functions (radial solutions of wave equation);

R – *Rydberg constant*; r_0 and υ_0 – *Bohr radius* and *speed*, respectively;

r_e – *radius* of the wave spherical shell of an *electron*, $r_e = 4.17052597\cdot 10^{-10}\ cm$;

ω_e – *fundamental frequency* of atomic and subatomic levels, $\omega_e = 1.869162469\cdot 10^{18}\ s^{-1}$;

$\hbar_e$ – *own moment* of momentum of an *electron*, $\hbar_e = (2/5)m_e\upsilon_e r_e$, ($\upsilon_e = \upsilon_0(r_e/r_0)$);

e – *elementary quantum* of the *rate* of mass exchange ("*electron* "*charge*"),

$e = m_e\omega_e = 1.702691665\cdot 10^{-9}\ g\cdot s^{-1}$;

m_0 and m_e – *associated masses* of the *proton* and *electron*, respectively;

c – *basis speed* of the *wave exchange* at the atomic and subatomic levels (speed of light is equal to this value);

$\lambdabar_e = c/\omega_e$ – *fundamental wave radius*, $\lambdabar_e = 1.603886998\times 10^{-8}\ cm$.

Note that the parameters: r_e, ω_e, $\hbar_e$, $\lambdabar_e$ – fundamental physical constants following from the Wave Model, previously unknown to modern physics.

Parameters: e, m_0, c – fundamental physical constants of modern physics, whose true physical meaning was clarified thanks to the WM.

It should be emphasized once again that for the electron charge e both its true value and dimensionality were discovered:

$$e = 1.702691665 \cdot 10^{-9}\ g \cdot s^{-1}$$

This means that at last (thanks to the WM) we knew the nature of electric charges.

The *first term* in (4.2), $-\frac{\upsilon_0}{c} e r_0$, corresponds to the orbital magnetic moment calculated by the equation (1.21) (where the true value of the average current $I = 2e / T_{orb}$ is used):

$$\mu_{orb} = \frac{1}{c}\left(\frac{2e}{T_{orb}}\right) S$$

It is equal in value to the orbital magnetic moment of the electron $\mu_{orb,\exp}$ initially obtained (1.3) in the Einstein-de Haas experiments,

$$-\frac{\upsilon_0}{c} e r_0 = -\frac{e\hbar}{m_e c} = \mu_{orb,\exp} \tag{4.4}$$

In absolute value, $\mu_{orb,\exp}$ is equal to the doubled value of the Bohr magneton (and also the doubled value of the spin magnetic moment without taking into account the correction, «anomaly», determined later):

$$\mu_{orb,\exp} = 2\mu_B = 2\mu_{e,spin} = \frac{e\hbar}{m_e c} \tag{4.5}$$

The *next terms* in Eq. (4.2) take into account the subsequent correction – «*anomaly*». Namely, the *second term* determines the contribution (in the orbital magnetic moment of the electron) of the disturbance caused by vibration of the center of mass of the hydrogen atom, as a whole, in the wave spherical field of exchange, limited by the wave radius $\lambda\!\!\!^{-}_e$ (the oscillatory region of the atom),

$$\delta\mu_{orb,1} = -\frac{e\upsilon_0}{c} \lambda\!\!\!^{-}_e \sqrt{\frac{2Rh}{m_0 c}} \tag{4.6}$$

The wave motion causes oscillations of the wave spherical shell of the hydrogen atom, limited by the Bohr radius r_0, together with the electron moving along the orbit. The *third term* in (4.2)) takes these oscillations into account:

$$\delta\mu_{orb,2} = -\frac{e\upsilon_0}{c} \frac{r_0}{b'_{0,1}} \sqrt{\frac{2Rh}{m_0 c}} \tag{4.7}$$

where $z_{0,s} = b'_{0,1} = 2.79838605$ is the first root of the spherical Bessel functions of the zero order.

According to the Dynamic Model of elementary particles (which is one of the two theories of the WM), an electron, like a proton (or like any elementary particle), is a dynamic spherical formation. Therefore, the own vibrations of the centre of mass of the electron, caused by different reasons, also take place. The fourth term takes into account the contribution of these vibrations,

$$\delta\mu_{orb,3} = -\frac{e\upsilon_0 r_0}{c}\left(\frac{2\beta}{(y_{0,1}+y'_{0,1})}\sqrt{\frac{4\pi R\hbar_e}{m_e c}}\right) \quad (4.8)$$

This term, including the parameter $\hbar_e = (2/5)m_e\upsilon_e r_e$ (where r_e is the radius of the wave spherical shell of an electron), obviously, is related to the own motion of the electron and, hence, corresponds to its own (spin) magnetic moment.

As follows from the Wave Model, $r_e = 4.17052597\cdot 10^{-10}\,cm$.

Small empirical coefficient $\beta = 1.022858$ compensates for some uncertainty of the radial solution (roots of Bessel functions) and the linear speed υ_e of rotation of an electron around its own axis (at the equator of its wave spherical shell of radius r_e) defined by the relation $\upsilon_e = \upsilon_0(r_e/r_0)$, where υ_0 and r_0 are, respectively, the Bohr speed and radius.

The contribution of $\delta\mu_{orb,3}$ to the total magnetic moment of the orbiting electron (4.3) is insignificant

$$\mu_{e,spin} = \delta\mu_{orb,3} = 5.609964\cdot 10^{-29}\ J\cdot T^{-1} \quad (4.9)$$

and is 0.0003%, compared with an incredible 50% contribution to the total magnetic moment of the spin magnetic moment, $\mu_{e,spin} = -9.284764620\cdot 10^{-24}\ J\cdot T^{-1}$, assigned erroneously to the electron.

Intra-atomic oscillatory-wave processes, taken into account in Eq.(4.2), perturb (modulate) the orbital motion of the electron, which manifests itself, in particular, in the phenomenon of the "anomalous" magnetic moment of the electron and in the phenomenon called the Lamb shift.

In equation derived in the framework of the WM (4.2), there are no integrals. The orbital magnetic moment of an electron (taking into account the “anomaly”) is easily to compute with help of a calculator.

3. “Anomaly” and g-factor according to the WM solutions

Since $-\frac{\upsilon_0}{c}er_0 = -\frac{e\hbar}{m_e c}$, equation (4.2) can be presented (similar to equation (2.10) of QED for $\mu_{e,spin}$) as

$$\mu_{orb,WM} = -\frac{e}{m_e c}\hbar(1+\alpha_{e,WM}) \quad (4.10)$$

where $\alpha_{e,WM}$ is the “anomaly” related to the orbital motion of an electron.

From Eq. (4.2) for $\mu_{orb,WM}$, it follows that the explicit (complete) form of the expression for $\alpha_{e,WM}$ is:

$$\alpha_{e,WM} = \frac{1}{r_0}\left(\lambda\!\!\!^{-}_e + \frac{r_0}{b'_{0,1}}\right)\sqrt{\frac{4\pi R\hbar}{m_0 c}} + \frac{2\beta}{(y_{0,1}+y'_{0,1})}\sqrt{\frac{4\pi R\hbar_e}{m_0 c}} \quad (4.11)$$

The indisputable advantage of this expression, obtained within the WM, is clearly seen when comparing it with an incredibly cumbersome formula for α_e (3.1) following from QED.

Thus, a formula connecting the orbital magnetic moment of an electron with the notions of g-factor and “anomaly” has, in the WM, the following form:

$$\mu_{e,WM} = -g_{e,WM} \frac{e}{m_e c} \hbar = -2\mu_{\mathrm{B}}(1+\alpha_{e,WM}) \tag{4.12}$$

In the WM, the anomaly $\alpha_{e,WM}$ and $g_{e,WM}$-factor are parameters that characterize the behaviour of a bound electron. That is, they relate to its orbital motion, but not to the motion of a free electron unbound to an atom (as it is accepted to consider the ge and ae parameters in QED).

The g-factor for the orbiting electron is equal to

$$g_{e,WM} = (1+\alpha_{e,WM}) \tag{4.13}$$

Since

$$g_{e,WM} = \left|\mu_{e,\exp}\right| / 2\mu_{\mathrm{B}} = 1.000579826 \tag{4.14}$$

the "anomaly“ is:

$$\alpha_{e,WM} = g_{e,WM} - 1 = 5.79826 \cdot 10^{-4} \tag{4.15}$$

It makes sense to emphasize once again that the anomaly α_e and the g_e-factor are parameters attributed in modern physics to a free electron. This is a consequence of the subjective assignment to the electron of the concept of spin of relatively enormous value of $\hbar/2$, which is an inadequate reality.

4. The fundamental meaning of the ratio of mechanical and magnetic orbital moments

Thus, the ratio of the magnetic moment to the moment of momentum of the orbiting electron,

$$\frac{\mu_e}{\hbar} = \frac{e}{m_e c} \ , \tag{4.16}$$

corresponds to Einstein’s-de Haas’s experiment.

As was discovered in the WM, the electron charge e is the elementary quantum of the rate of mass exchange. It is equal to the product of its associated mass m_e and the fundamental frequency $\omega_e = 1.869162559 \times 10^{18}\ s^{-1}$ of the atomic and subatomic levels:

$$e = m_e \omega_e \tag{4.17}$$

Substituting (4.17) into (4.16), we arrive at the following result:

$$\frac{\mu_e}{\hbar} = \frac{e}{m_e c} = \frac{\omega_e}{c} = \frac{1}{\lambdabar_e} = k_e \tag{4.18}$$

The data obtained mean that the ratio of the moments (4.16) is of fundamental importance. It is equal in magnitude to the fundamental wave number k_e, related with the fundamental frequency ω_e and the fundamental wave radius $\lambda\!\!\!^{-}_e$ [25, 26].

The above data are in accordance with the objective theory of electromagnetic processes (described in the WM) [4]. Relations (4.18) are also valid for proper moments.

Part 5. Advantage of WM over QED

1. Comparison of equations for "anomaly"

Approaching the end, it should be recalled that orbital magnetic moment of an electron, following directly from equation (4.2) of the Wave Model (WM), is

$$\mu_{orb,WM} = -1855.877461 \cdot 10^{-26}\ J \cdot T^{-1} \tag{4.3}$$

The contribution of the spin magnetic moment in (4.3) is insignificant:

$$\mu_{e,spin,WM} = 5.609964 \cdot 10^{-29}\ J \cdot T^{-1}$$

The value $\mu_{orb,WM}$ (4.3) coincides with the value of the orbital magnetic moment, following from Quantum Electrodynamics (QED), when summing the two components of the moment, (3.3) and (3.4), roughly equal in value, that is:

$$\mu_{orb,QED} = \mu_{e,spin} + (-\mu_B) = -1855.8774614 \cdot 10^{-26}\ J \cdot T^{-1} \tag{3.9}$$

where $\mu_{e,spin}$ is actually that half of the μ_{orb}, which was lost at the calculations, with allowance for "anomaly" $\mu_{e,spin} = \mu_{orb,th}(1+\alpha_e)$, and $-\mu_B = \mu_{orb,th}$.

Compare now the *calculation equations for the* "*anomaly*" obtained in both theories.

By QED (<u>*abbreviated form*</u>):

$$\begin{aligned}\alpha_e = 0.5\left(\frac{\alpha}{\pi}\right) - 0.328478965579...\left(\frac{\alpha}{\pi}\right)^2 + 1.181241456...\left(\frac{\alpha}{\pi}\right)^3 - \\ -1.5098(384)\left(\frac{\alpha}{\pi}\right)^4 + 4.382(19)\times 10^{-12} = 0.0011596521535(12)\end{aligned} \tag{3.1}$$

where $\alpha = e^2/(4\pi\varepsilon_0\hbar c)$ is the fine-structure constant.

All pages of this article are not enough if we would like to place the formula (3.1) in the explicit complete form of all integral expressions for the coefficients in the terms of the expansion.

The numerical coefficients in the equation were calculated using supercomputers.

By WM (<u>*complete form*</u>):

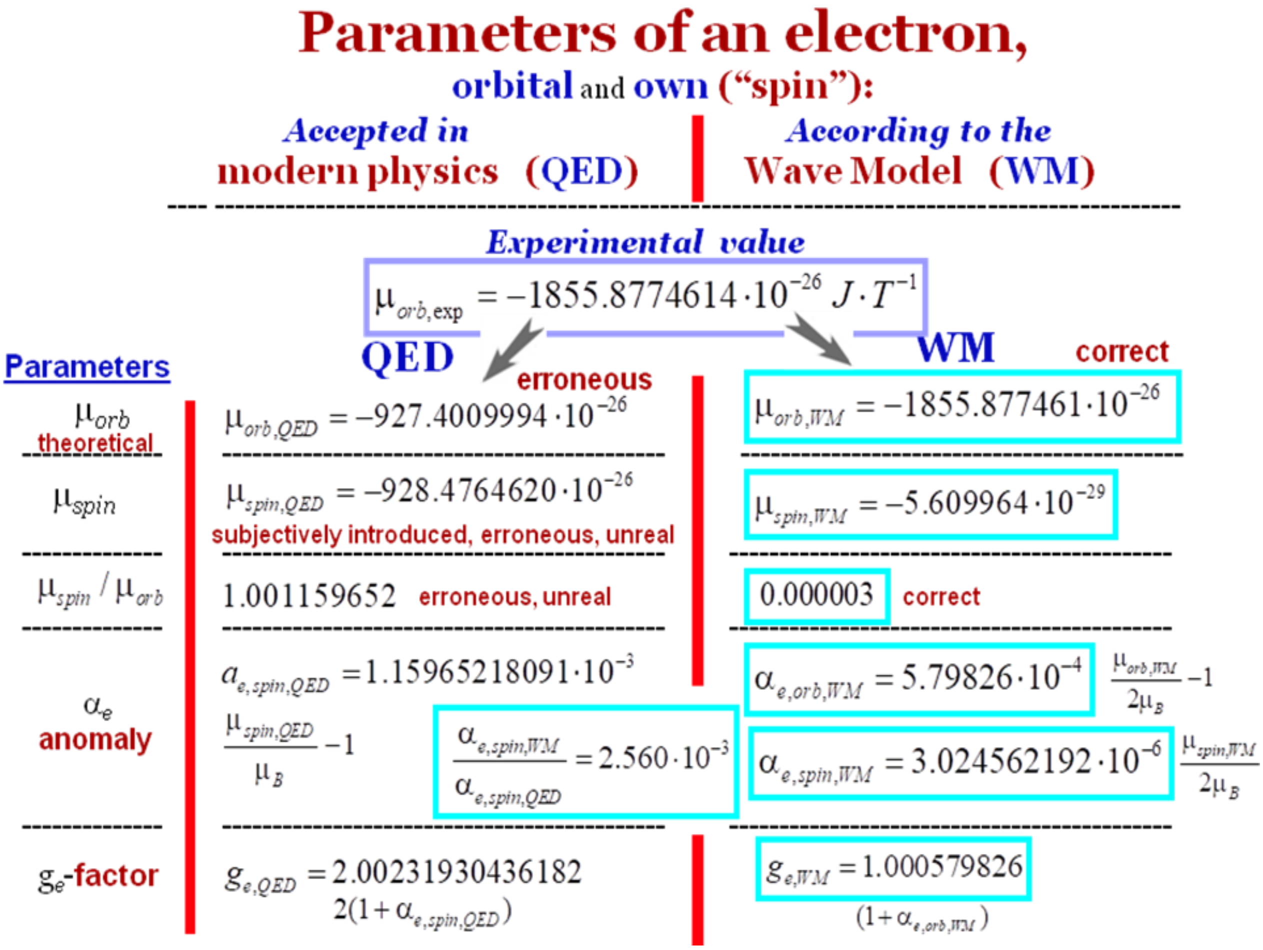
$$\alpha_{e,WM} = \frac{1}{r_0}\left(\lambda\!\!\!^{-}_e + \frac{r_0}{b'_{0,1}}\right)\sqrt{\frac{4\pi R\hbar}{m_0 c}} + \frac{2\beta}{(y_{0,1}+y'_{0,1})}\sqrt{\frac{4\pi R\hbar_e}{m_0 c}} \tag{4.11}$$

where $b'_{0,1}$, $y_{0,1}$, $y'_{0,1}$ are roots of the Bessel functions.

To calculate $\alpha_{e,WM}$ *, a simple calculator is enough.*

2. Comparison of the obtained parameters

The parameters discussed in this article, obtained in both theories, QED and WM, are summarized in the table below in such a visual form so that you can immediately clearly see the difference between them.



There is no need to additional comments to the data presented in the table. All parameters shown here were discussed in detail in this article. The advantage of the Wave Model over Quantum Electrodynamics, which adheres to the Standard Model that dominates modern physics, is clearly seen. There is no doubt in that.

Conclusion

I

A gross error in physics has been revealed. As we found out, this error happened when calculating the orbital magnetic moment of an electron in an atom by the formula

$$\mu_{orb} = (I / c)S \ ,$$

where the mean value of the circular current *I*, created by a discrete charge moving along an orbit, was taken in the form

$$I = e / T_{orb} \ ,$$

as indicated in all sources, including fundamental university textbooks on physics. As it turned out, this formula for current *I* is erroneous. The cause of the error was identified.

The true average value of the circular current turned out to be two times larger, that is,

$$I = \frac{2e}{T_{orb}}$$

that has been convincingly proven.

II

The arguments given in this article are convincing enough to claim that the electron spin of $\hbar/2$ was erroneously introduced in physics. Accordingly, the spin magnetic moment of an electron, corresponding to the spin,

$$\mu_{e,spin} = -\frac{1}{2}\frac{e\hbar}{m_e c}$$

is erroneous as well.

The own moment of momentum (spin) of an enormous value of $\hbar/2$ was formally (arbitrarily, subjectively) attributed to a free electron to compensate for the error in two times made by physicists-theorists when calculating μ_{orb}. In modern physics, it is generally accepted that, with allowance for the anomaly α_e,

$$\mu_{e,spin} = -\frac{1}{2}\frac{e\hbar}{m_e c}(1+\alpha_e) = -928.4764620 \cdot 10^{-26} \ J \cdot T^{-1}$$

This parameter, attributed to the electron as some kind of intrinsic (quantum, non-mechanical) property, has nothing in common (just as the electron spin of $\hbar/2$) with the real parameters actually inherent in the electron, like its mass and charge. There are no experimental evidences to support the existence of the above parameters, characteristic, as believe, for free electrons (unbound with atoms).

III

By definition accepted in physics, the gyromagnetic ratio γ of a particle or system is the ratio of their magnetic moment to angular momentum, and it has the form,

$$\gamma = \frac{q}{2mc}$$

For an electron,

$$\gamma_e = \frac{\mu_e}{\hbar} = \frac{e}{2m_e c}$$

Both above equalities are erroneous, twice less than real (the presence of the number 2 in the denominators appeared due to an error in the calculations).

The correct expressions for the gyromagnetic ratios, γ and γ_e (revealed thanks to the Wave Model), are as follows:

$$\gamma = \frac{q}{mc} \qquad \text{and} \qquad \gamma_e = \frac{\mu_e}{\hbar} = \frac{e}{m_e c}$$

These expressions are valid for both orbital and own moments.

The gyromagnetic ratio $\gamma = q / mc$ is of fundamental importance.

For the electron, the gyromagnetic γ_e ratio is associated with the fundamental physical constants discovered in the WM – fundamental frequency ω_e of the atomic and subatomic levels, fundamental wave radius $\lambda\!\!\!^{-}_e$, and the fundamental wave number k_e – by the following equality,

$$\gamma_e = \frac{\omega_e}{c} = \frac{1}{\lambda\!\!\!^{-}_e} = k_e$$

IV

The hypothesis of virtual photons, which an electron allegedly emits and absorbs, and which, as believe, lead to a change in the effective mass of the electron and, as a consequence of that, to the appearance of anomalous magnetic moment in it, is also erroneous.

Therefore, the direct derivation of the "anomaly”, based on the mystical influence of the hypothetic (virtual) particles, naturally, proved to be an insoluble problem.

For this reason, to derive an equation for the “anomaly”, QED theorists were involved in complex mathematical manipulations, using the method of sophisticated fitting.

The highest degree of "perfection" was achieved in this case that clearly seen from the very complex and cumbersome resulting equation for anomaly α_e that requires for its solution the use of supercomputers. Therefore, we were able to place and shown in this article only its abbreviated form (3.1).

V

Within the Wave Model, the orbital magnetic moment of the electron (μ_{orb}) is derived in a natural way and logically flawlessly, that is clearly seen from the simple (complete, explicit) equation (4.2), in which the "anomaly" (α_e) is directly taken into account.

The value of the orbital magnetic moment of the electron (4.3)

$$\mu_{orb,WM} = -1855.877461 \cdot 10^{-26} \ J \cdot T^{-1}$$

obtained in the WM from Eq. (4.2) (note once more, without using the postulate on virtual particles) completely coincides with the last known experimental value (3.9).

For calculations it is enough to have a simple household calculator.

※ ※ ※

Thus, "electron spin” is a fictional parameter. It has nothing to do with a mechanical rotation of an electron around its own axis, which only could cause the own magnetic moment. By definition accepted in quantum physics, electron spin is some kind of *quantum parameter* (intrinsic, *non-mechanical*) of the electron. Accordingly, in principle, it cannot cause a magnetic moment, which is the parameter of *mechanical* motion.

Therefore, the detection of non-existent intrinsic magnetic moments of free electrons directly on free electrons has not been carried out and is not undertaking in physics. Obviously, physicists understand the senselessness of trying to find something that does not exist in reality.

Taking into account all the data, including presented here, quantum electrodynamics (dominant theory of modern physics) can be compared figuratively, by analogy, with the Tower of Babel, moreover, with its worst option, since it is building on a ghostly foundation – fictional subjectively introduced abstract-mathematical postulates. This means that at present, the Standard Model of modern physics, where QED is considered as the main and the most effective theory, is on the wrong track.

Judging by all the results presented both here and in other publications from 1996 to the present (they can be found on the author’s website http://shpenkov.com), WM can be considered as a real replacement for the SM.

It is very important to remind that the whole chain of questionable concepts, associated with the creation of QED, began with the use of an erroneous formula for the average current $I = e/T_{orb}$ generated by the orbiting electron.

Surprisingly, so far almost for a century, no one paid attention to this formula, mentioned in almost all relevant physics textbooks, which led to serious unpleasant, as we see, consequences for physics.

Afterword

ONE ERROR – HUGE CONSEQUENCIES!

Erroneous concepts (abstract-mathematical postulates) are in the base of the modern physics theories adhering to the Standard Model. They in turn have given rise to numerous subjective (“fundamental”) constants. All this complicates cognition of the Universe, or even makes it impossible, in particular, at the atomic level.

Experiments based on the erroneous concepts are unable to detect the accumulated errors. Thus, everything is formally “right” and “consistent”.

Wrong concepts give rise to false theories, within which formally correct results are possible only on the basis of new errors – in full agreement with the dialectical law of double negation:

$$No_1 \cdot No_2 = Yes$$

where No_1 is the initial lie, No_2 is a new lie, and *Yes* is the formal truth. The result of this course of events can be only one – a dead end.

However, as we see, not everything is so hopeless. Judging by the obtained results, the Wave Model, based on the new paradigm, can really replace the Standard Model that dominates modern physics, and change the unfavourable trend characteristic of the modern development of physics.

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