«Fundamental atom-molecular engineering». Part 1. Model of electron

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Tell me what electron is and I will be able to explain all the rest.
W.Tomson

The present chapter investigates electron. It is shown that electron has an intricate internal structure which determines both static and dynamic properties of the electron itself and important parameters of te condensed matter.

Stationary "cold" electron (≤0.1eV) is modeled by a thin elastic ring called ector having diameter which is 137,036 times larger Bohr's radius of hydrogen which consists of specific form of magnetic field. On the basis of the ector model the size, mass, charge, electromagnetic mass, spin and magnetic moment of electron are described. The model of "cold" ring electron in a condensed matter explains from new perspective critical parameters of phase transitions "metal-semiconductor" (Winner's crystallization) and low temperature and high temperature superconductivity.

Ring electron spirals into a void torus as compared to steady moving "hot" electrons (>>0.1эВ). The size of the torus depends on its kinetic energy which makes it possible to describe changes of the cross-section of the interaction with gas – Ramsauer effect. The model of ring electron transforming onto the torus also makes it possible to construct a hydrogen atom and describe energy states of the atom including its spectrum, process of emission/absorption, size of the atom and its stability.

The model of the toroid electron explains correlation of the change of the interacting cross-section of relativistic electron with accelerating electro-magnetic wave up to complete disappearance of the interaction called disruption in the energy spectrum of cosmic electrons.

Very high coincidence degree with the experimental data and simplicity of formulas testify to the adequacy of the employed model.

Introduction

It is believed that electron is explained by the laws of quantum mechanics. We understand by the term "quantum mechanics" a theory which lays down the method of description and the laws of movement of physical systems for which the values which characterize the system and have a range of effect correlate with the Planck constant *h*. Laws of quantum mechanics constitute a foundation of the modern theory of the structure of matter. It is considered that they made it possible to ascertain structure of electron shell of the atom and to decipher atomic and molecular spectrums, to determine nature of chemical bonding, to explain Mendeleev periodic table of elements and to understand structure and properties of atomic nuclei. Emergence of quantum field theory – quantum theory of relativistic systems having infinite number of degrees of freedom gave further impetus to the development of quantum mechanics. It has provided a theoretical foundation for explanation of micro-particles, their interaction and inter-transformation. According to modern views quantum field is the most universal form of the matter which lays at the foundation of all of its concrete manifestations. Quantum electrodynamics which constitutes the quantum theory of interaction between Maxwell electro-magnetic field and Dirac electron-positron field is the most important aspect of the quantum field theory.

Over the last decades of XX century new technological revolution based on nano-technologies has started. Creation of new devices capable of detecting, measuring and

manipulating with separate atoms and molecules lies at the root of this revolution. However significant problems of description of newly accumulated experimental data by means of classic quantum mechanics and quantum field theory attended the new super-accurate measurements.

In the eighties these problems were touched upon by Dirac, one of the founders of quantum mechanics "Proceeding from modern foundations of quantum mechanics people has done a lot of hard work in order to find examples corroborating the rules of removing infinity when solving equations. But all these rules are artificial despite the fact the data stemming from the rules may correlate with the experience. I cannot agree that modern foundations of quantum mechanics are correct".

Hence it became necessary to revise foundations of quantum mechanics and quantum electrodynamics in order to break traditional world view and to come up with more adequate theories explaining modern experimental data and precipitate the process of the world nano-revolution.

First part of the present work deals with analysis of problems of quantum mechanics and quantum electrodynamics stemming out of usage of particles as non-structural dots or "probability wave" which are assigned with mass, charge and spin for the primitive basic models. The conclusion is made that classic quantum mechanics and quantum electro-dynamics lead to the following contradictions and paradoxes:

1. Exceeding of the atom size in excited state as compared to the experimental data.
2. Solution of equations of quantum mechanics is made without taking finiteness of interaction speed between the electron and the nucleus into account.
3. Absence of boundary conditions when solving wave equations brings about the possibility of electron location both in the center of the nucleus and in the infinity, which lacks experimental confirmation so far.
4. Schredinger and Dirac equations for hydrogen atom (l=0) are not equations of steady movement of the electron around the nucleus.
5. Addition of relativist amendment to Sommerfeld equation for thin structure of spectrums leads to loss of stability of movement of the electron around the nucleus.
6. Dirac relativist equation for the free electron leads to a paradox – appearance of orbital moment of the electron while the nucleus is absent.
7. Dirac relativistic Dirac equation on free electron leads to another paradox – the projection of electron's velocity on axes of coordinates equals the speed of light, although any particle which has mass at rest cannot move with the speed of light in principle.
8. Dirac relativistic Dirac equation on free electron leads to yet another paradox – appearance of negative energy for the anti-particle.
9. Electro-magnetic emission of electron which moves around the nucleus leads to impossibility of existence of atom according to equations of Bohr, Schredinger and Dirac. Atoms stability is postulated both in classic and quantum electrodynamics.
10. «Probability wave» in equations of Schredinger and Dirac cannot in principle emit and absorb electro-magnetic waves. This process is postulated in quantum electrodynamics.
11. Effective size of an atom as the antennae for emission/absorption of the electro-magnetic wave is close to zero. However in quantum electrodynamics this efficiency is postulated as equal to one.
12. The Lamb shift and anomalous magnetic moment of electron are interpreted as interaction of the electron with virtual particles in the "physical vacuum" without any dissipation of the electron energy. In such a case the law of conservation of energy of electron is being violated since the "friction" does not cause the absorption of energy. A new unobserved phenomenon is being introduced to physics – virtuality of energy.
13. The existing apparatus of quantum mechanics does not make it possible to determine atomic radius of the matter, parameters of the lattice and the ones of phase transitions.

Classic quantum mechanics has only one and only accurate solution where empirical coefficients are not used. This is the solution concerning atom of hydrogen and a special case for H_2^+. Following this solution a global conclusion about impeccability of quantum mechanics is being made. However Schredinger and Dirac equations for atom of hydrogen (l=0) are not equations of stable movement of electron around the nucleus (Part 1). It casts doubts on credibility of such a profound generalization.

The purpose of the present series of works is to lay down foundations of atom-molecular engineering. The foundations are based on new determined models of electron, proton and neutron which have intricate internal structure. It is the internal structure of the particles which determines their external fields and as a result the interaction between the particles. If one knows the internal structure of every elementary particle one can construct models of atoms and molecules corresponding to experimental data and to describe condensed state of the matter, formation of nano-objects and to calculate critical parameters of the matter. It is impossible to move forward nano-technologies and their wide industrial application without this knowledge.

Hence development of theoretic foundations of nano-technology is impossible without understanding of nuclear physics and physics of elementary particles, i.e. femto-technology. We understand under the tem "femto-technology" investigation and control of processes taking place within nuclear distances (10^{-15}м) up to atomic distances (10^{-9}м).

Model of electron

Traditionally elementary particles and atoms were regarded as intricate structural objects. Even in 1867 lord Calvin described atoms as knot-like vertical ether tubes analogical to electromagnetic vortexes of Faraday and Maxwell. J.J.Tomson who was a pioneer-discoverer of electron also thought that electron looked like a ring. At the beginning of the 20th century this model was generally accepted which fact was used by Nicholson when he created his quantum model of atom. There was an electronic ring which rotated around the nucleus in his model. A year before Bohr created his model of atom it was Nicholson who was the first to used Planck's constant in order to describe movement of the electronic ring rotating around a small nucleus and he also calculated the spectrum of helium. Then Bohr started using Nicholson's model to describe atoms, internal atom's electrons, Bohr used Rutherford's planetary model by representing electron as a non-structure dot. [1] Symbiosis of these two models has led quantum mechanics to a dead-end (Part 1). That is why it is necessary to restore historic justice and come back to the ring model of electron having updated the model by means of modern achievements of modern physics.

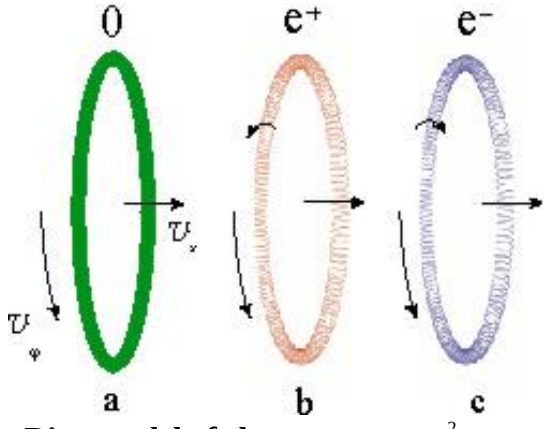

Fig. 1. Ring model of electron. $v_\varphi = \alpha^2 c,\ v_x < \alpha^2 c$.

Any form of matter or field possesses specific density of energy which can be formally described as some vibrant environment. Then the electron can be represented as a thin elastic

ring consisting of specific type of electro-magnetic field. (Pic.1a). Let us name such electromagnetic torus as **"ector". In order to represent the electron in such a way its model needs to explain the size, mass, charge, electro-magnetic mass, spin, magnetic moment, leptonic charge. The model must describe the change of cross-section of interaction with the gas and condensed matter depending on the speed of movement, Cherenkov's emission, diffraction of electrons on the lattice, conductivity and superconductivity for steady moving electrons. If the electron moves with acceleration its model should explain parameters of electromagnetic emission (synchronic emission, deceleration emission, relativistic increase of the mass, change of interacting cross-section with the accelerating electro-magnetic wave up to the full disappearance of the interaction.**

The size of the "cold" electron

Free electron in a stationary state which has energy ≤0.1 eV shall be considered "cold" electron. The diameter of such electron can be experimentally determined by "tunneling" the electron between metal electrodes through vacuum gap. It is established experimentally that if the voltage between the electrodes is 0.1-0.2 V then the tunneling effect disappears if the electrode separation is less than 8 nm. [2]. This very important experimental fact is being constantly ignored because it contradicts with the wave quantum mechanics. There is a quite spectacular experiment concerning "levitation" of the electrons which also determines the diameter of the "cold" electron. When a hot cathode emits electrons on the surface of liquid helium or on the surface of solid inert gas the electrons stop and cool down. As a result of this cool-down one can observe a monolayer of levitating electrons at the height of 7.6 nm. At the same time the electron separation in the monolayer is about 15 nm which causes their maximum surface density. [3]. This effect was theoretically connected with electrostatic interaction between the electrons and the dielectric which has very low coefficient of permittivity.

These two experiments are very easily explained by the ring electron theory.

Let us establish the radius of such ring electron through the cosmological constants [4]:

$$r_0 = \hbar/(m_e\alpha^2 c) = 7{,}2517 \text{ nm.} \qquad (1)$$

$\hbar$ is the Planck constant, m_e is the electron mass, α is the constant of the fine structure, c is the speed of light.

It should be noted that the size of this electron is exactly α^{-1} = 137,036 times bigger that the radius of atom of hydrogen.

Mass and charge of the electron

It is known that the mass and charge of the electron are determined experimentally. Moreover, in all the experiments not only mass and charge are measured but the charge-to-mass ratio. As a rule a formal mathematical division of this ratio is provided then, i.e. the charge is artificially separated from the mass. It results in a distortion of the real picture and wrong formulation of the equations of the mathematical physics. For example Lorenz electrodynamics does not take electron mass into account while in the Einstein theory the electron charge is lost.

Besides, a problem of kinetic and gravitational mass of the electron appears. It is generally accepted that mass means a fundamental physical value which determines inertia and gravitation of objects – be it macroscopic objects or atoms and elementary particles in non-relativistic perspective. It is Einstein's contention that the kinetic mass and gravitational mass are always equal. But long time ago Poincare used to say "Mass-inertia ratio grows together with the speed. Should we conclude out of this that the mass – the attraction ratio grows together with the speed and remains proportional to the inertia ratio or should we conclude that the attraction ratio remains constant? It is the question which is completely impossible to solve for us". [5, p.507].

A perfectly legal question arises: does the electron have the gravitation mass and what is the nature of this gravitation? All known measurements of gravitational interactions pertain only to molecules, atoms and the condensed matter. Out of all experiments conducted to determine the gravitational interaction of elementary particles the only reliable data obtained refers to the

gravitational interaction of neutrons. That is why available experimental data does not warrant a definition of the kinetic mass of the electron as equal to its gravitation mass. In the article [6] regarding the model of atom of hydrogen it was demonstrated the gravitation constant is defined through electro-magnetic constants and the mass of the proton. In this case the gravitation is defined by the residual electromagnetic field which is formed as a result of the imperfect coverage of the positive field of the proton by the negative field of the electron e. The physical quantity of this field equals $\alpha^8 e$. It will be shown further that the similar undercompensation of the magnetic fields can be witnessed in the neutron and it determines its gravitational properties. I.e. only compound systems of the unsimilar charges possess gravitational properties. That is why we can maintain that the electron as an elementary particle with one digit charge does not have the gravitation mass.

It follows out of the model of the ring electron that the kinetic mass of the electron can be expressed by the kinetic mass of the fine rotating elastic ring.

Let us determine **rotational velocity** of such ring. It can be determined by the frequency of resonance absorption of the electromagnetic wave by cold "levitating" electrons 126-148 GHz [3]. It should be noted that some of this energy is wasted when the electron interacts with the surface of liquid helium. Consequently the frequency of rotation of the electron can be defined through the cosmological constants in the following way:

$$f = \frac{m_e\left(\alpha^2 c\right)^2}{2h} = 1.75185\ 10^{11}\ \text{Гц} \qquad (2)$$

Then the rotational velocity of the electron ring around its axis is determined by the value of $\alpha^2 c$. The velocity $\alpha^2 c$ shall be called the **first critical velocity of travel of the free electron in space.**

Charge is a physical quantity determining the source of the field by means of which the particles interact. It is electromagnetic field if we talk about electrons and protons.

The notion of charge is introduced empirically in all existing theories. We on the contrary introduce the notion of charge as logical corollary which follows out of our model.

Let us consider that the cross-section of the electron ring is a circle (Pic.1). A small segment of this ring can be represented as a cylindrical bar (thin line) exposed to the torque moment. The bar is elastic so its deformation is insignificant and it has a given elasticity coefficient. As a result of force of the two torque moments the two cross-sections of the bar take angle of a torsion of a bar φ at a given distance l. The number of complete revolutions N_α of the angle of torsion $\varphi = 2\pi \cdot N_\alpha$ along the length of the bar $2\pi r_0$ can be derived out of the experiment of fine fission of spectrums of hydrogen-like atoms – multiplicity of the term. It follows from equations on fine fission that when the charge of the nucleus is Z=1 then the number N_α^* close to 861 appears.

$$N_\alpha^* = \frac{2\pi}{\alpha^*}\sqrt{1-\alpha^{*2}} = 861 \pm \delta, \qquad (3)$$

where δ is a small addition, α^* is a dimensionless coefficient. We shall interpret the whole part of N_α^* as a full number of revolutions of the angle of torsion is N_α. Moreover, in this case the dimensionless coefficient α^* is the fine structure constant. It follows out of (3) that it is possible to get theoretical value of the fine structure constant α^{-1}= 137,0360547255..., which coincides with the experimental value up to the seventh digit of the value number. It follows then that α is geometric dimensionless property of space which is definitely connected with N_α and π.

On the other hand the constant of the fine structure can be represented through cosmological constants in the following way:

$$\alpha = \frac{z_0}{4\pi}\frac{e^2}{\hbar} = \frac{e^2}{4\pi\varepsilon_0\hbar c}, \qquad (4)$$

In this formula $z_0 = \sqrt{\frac{\mu_0}{\varepsilon_0}}$ – is wave resistance of the vacuum, μ_0 and ε_0 are magnetic and dielectric permittivity of the vacuum, *e* is the charge of the electron.

Consequently, we can connect geometrical properties of the ring electron with its charge *e*, the mechanical torque moment of the ring – quantum of action $\hbar = r_0 \alpha^2 c m_e$ when the electron travels in the vacuum at wave resistance z_0.

It follows that we can define the charge as the revolution of the body of the ring where the full number of revolutions is 861. In this case the sign of the charge is determined by the direction of torsion relative to the direction of the torsion of the ring as a whole. Let us consider for convenience the electron is left torsion and positron is the right torsion (Pic. 1c).

Electro-magnetic mass of the electron

The concept of mass and charge of electron is closely connected with the concept of electro-magnetic concept of the electron. It is the portion of the kinetic mass of the electron which is concentrated in the electron external electromagnetic field. As a rule the electron is represented as a particle with the classic radius of $r_e = \alpha^3 r_0$. When calculating the energy and mass of electromagnetic field at boundary conditions r_e, ∞, a paradox occurs – all of the electron's mass is electro-magnetic. A question arises – what is the electron? Quantum mechanics easily circumvents this paradox – the electromagnetic mass is just being ignored.

For example, it follows out of Dirac relativistic theory of the free electron that eigenfunctions of the coordinate operator of a particle is not δ-function like in non-relativistic theory of Schredinger but they are "spread" along the area of the factor of Compton length of the wave $2\pi\alpha^{-1} r_e$ of the particle.[7,p.74]. It should be noted that if we take a classic radius of electron r_e, then the mechanical moment of the electron equals $\alpha\hbar/2$, which is 137 times less then the experimental quantity. In this case the revolution velocity of internal components of the electron is to be 137 times more than the speed of light. That is why Dirac had to introduce dimensions of electron which are 137 times larger than the classic radius by representing it like the Compton radius $r_c = \alpha^{-1} r_e$ in order to "save" the theory of relativity. This automatically led to new contradictions. As is generally known, Lorentz and Hamilton transformations are true only for mathematical point while some dimensional object appears without any explanation or substantiation in Dirac theory. [7].

Our model takes into account the electro-magnetic mass of the electron and the mass is derived experimentally. There are no known experiments to determine electro-magnetic mass of the "cold" ring electron. That is why let us examine electro-magnetic mass of the high-energy "hot" electron.

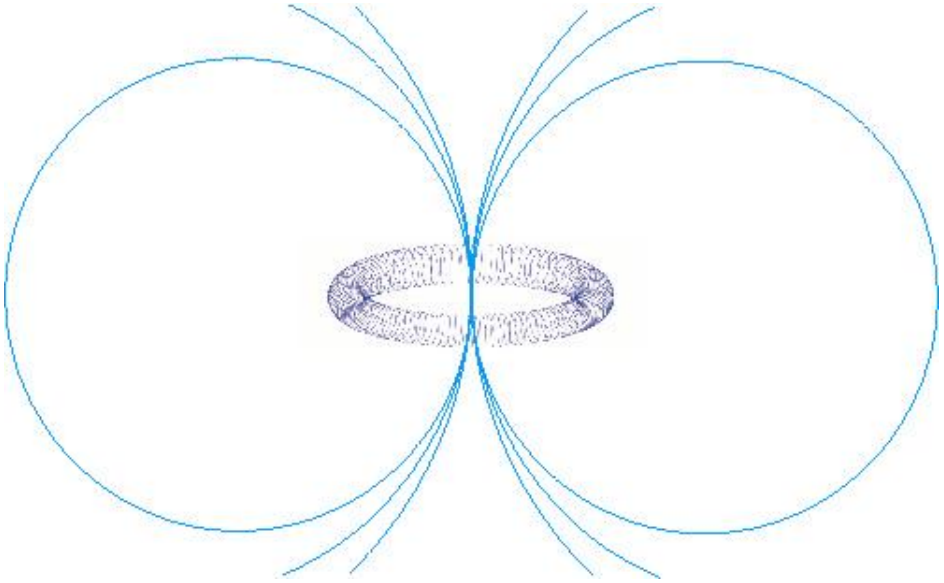

Fig. 2. Segmented electro-magnetic field of the electron which forms its electro-magnetic mass αm_e

In his classical theory of the field Ivanenko [8] introduces electro-magnetic mass as αm_e. Feinman also tries to substantiate existence of αm_e [9]. But they both failed to connect the mass with the known experiments. On the other hand experiments with electronic microscopes gave proof that the maximum resolving power of a microscope is limited by the quantity of $\alpha^{-1} r_e$ = 0.051nm for the condensed matter – i.e. Bohr's dimensions of the orbit of the atom of hydrogen and it is independent of the accelerating voltage up to 3 mega-erg V. Under this voltage the length of de Broglie wave of electron is about 0.0007nm but the resolving power does not exceed the dimensions of the atom of hydrogen anyway.

All endeavors to develop microscopes with better resolving power by enhancing quality of the electron beam and lenses fell through since the problem is much more serious. The problem boils down to the fundamental limit for the condensed matter – necessity of taking into account electro-magnetic masses of the electrons.

It is safe to contend that the electron is surrounded by electro-magnetic field having electro-magnetic mass of αm_e and the size which is at least 137 times bigger than the length of De Broglie wave of the probing electron. The model of the ring electron is shown at Pic.2, the electron is coiled into torus surrounded by toroidal field which forms the electro-magnetic mass of the electron.

It is the electro-magnetic mass what limits resolving power of microscopes by the size of the atom of hydrogen.

Spin and magnetic moment of the electron

Physics postulates the notion of spin as the intrinsic moment of quantity of travel of elementary particles having quantum nature and unrelated to the travel of the particle as a whole. The concept of spin was introduced into physics in 1925 by G Uhlenbeck and S. Goudsmit on the basis of analysis of spectroscopic data. They made an assumption that the electron can be treated as "spinning top" with its intrinsic mechanic moment of ½ and its own intrinsic (spin) magnetic moment which is equal to Bohr magneton $\mu_B = \hbar e / 2m_e$. Then for the electron spin the gyro-magnetic ratio is $\gamma = e / m_e$, i.e. it looks anomalous from the point of view of classical electrodynamics: for the orbital travel of the electron and for any travel of the classical system of charged particles with the given ratio e / m_e, it is 2 times less $(e / 2m_e)$.

It is impossible to introduce the concept of spin from the point of view of quantum mechanics both for the point electron and for the electron represented as a probability wave. That is why the notion of spin is being introduced purely formally on the basis of experimental data.

The concept of spin logically follows out of our model. It is generally known that there are only two degrees of freedom for the symmetric body.

The first degree of freedom determines mechanic torque moment (pulse moment) of the electron ring around its central axis.

$$\hbar = r_0 \alpha^2 c m_e . \qquad (5)$$

The second degree of freedom determines mechanic torque moment of revolution of the ring around the axis which goes through its plane. It equals $\hbar / 2$.

Consequently the 2 times difference of mechanical and magnetic moments in our model can be explained vector relations of the two directions of rotation. This explanation provides an alternative to the explanation which follows out of Dirac relativistic theories of the free electron and Thomas electron precession. [10].

Electron magnetic moment can be naturally defined out of the two degrees of freedom.

$$\mu_e = g \mu_B , \qquad (6)$$

There are no experimental data on the measurement of the anomalous magnetic moment of the ring "cold" electron. Therefore, anticipating things let us first review the experimental data on the "hot" electron – the one which is located on the upper electronic orbits of the atom.

It will be demonstrated below, any interactional environment (in our case – uniformly charged ring), when flattened (compressed) forms the only possible topologic structure – full torus [11]. Big radius of such torus of the electron is determined by the potential of its interaction with the nucleus. The major radius of the torus of the hydrogen atom will coincide with Bohr's radius of the electron orbit and is equal to

$$r_B = \alpha r_0 \qquad (7)$$

The ring electron itself coils into a spiral which forms geodesic curve on the torus. The number of revolutions of the spiral around the torus is 861. Thereby the torus is divided into 861 segments, so to speak. As a result the electron magnetic field becomes segmented as well. It consists of 861 "petals". Pic.2.

The interaction between the electron and the external electromagnetic field is realized through its transversal segments or "petals", it may be compared to the work of a gear coupling with 861 cogs. Since the experiments are performed with the whole set of particles rather than single particle this aspect is taken into account by introducing an additional member of square ratio $\hbar$/861 – ratio of the fraction of the main angle moment of the electron to the square of the mean quadratic meaning of the spin of the free electron $4/3N_\alpha^{-2}$.

If we consider such pattern of the interaction and the mean quadratic value of the spin then we can calculate the anomalous magnetic moment of the electron. It will be equal to

$$\mu_e = 2(1+N_\alpha^{-1}-4/3N_\alpha^{-2})\mu_B = 2\ (1.001159641595)\mu_B, \qquad (8)$$

μ_B – is Bohr's magneton. It coincides with the experimental quantity up to the seventh character after the comma. It should be noted that the ultimate experimental quantity consist if only 7 significant characters.

The existence of the anomalous moment of the electron led in its time to crisis of quantum mechanics. A new theory – quantum electrodynamics had to be created to explain it. The theory calls back the notion of "aether", it was represented as virtual electron-positron fields and one had to introduce the concept of friction of electron against such fields without dissipation of the energy which is in direct contradiction with the law of conservation of energy. Such fields and the analogous ones consisting of other particles and anti-particles were called "physical vacuum". So there were introduced unique notions into physics – "virtual" particles and "virtual" energy. It is recognized that the main argument giving credibility to quantum electrodynamics models is precise calculation of the anomalous magnetic moment of the electron

which exceeds by the factor of 3 or 4 the accuracy of cosmological constants which were measured experimentally! It is a totally wrong methodological approach as far as physics is concerned. That is why the author absolutely agrees with Dirac that the fundamentals of the quantum mechanics and quantum electrodynamics are not correct. All obtained experimental data can be interpreted on the basis of the deterministic and mechanistic approach. As a result a possibility in principle arises to unite classical mechanics and wave mechanics.

Dynamics of the ring electron

Let us find out how the electron travels in the free space and how the shape of the ring electron is transformed during the travel.

Let us review the experiment involving the travel of ring electrons in the inert gas in the external electric field. For example when liquid helium is heated the pressure of steam above it increases. The electric field is applied in such a way so that "levitating" electrons would start travel towards the anode through the gas. If minor fields are created the electrons barely interact with the atoms of the inert gas. Theses experiments are analogous to the experiments made by Ramsauer (Ramsauer C., 1921 г.), who observed effect of multiple decrease of the cross-section of the interaction at the energies of electron around 0.1÷1.0 eV when it travels through the inert gas [12].

Using our model we can explain why the cross-section of interaction of the electron is 100 times less than the cross-section of interaction at several eV in Ramsauer experiment when the energy of the electron is less than 0.1 eV.

On the basis of the suggested model, let us determine the potential difference which make the progressive motion of the electron equal to $\alpha^{-1/2}$ of the speed of rotation of the electronic ring:

$$V_k = \frac{m_e\left(\alpha^2 c\right)^2}{2\alpha e} = 0.09928 \text{ B}. \qquad (9)$$

Here the relation $\alpha e / m_e$ can be treated as the effective specific electronic charge which results from the interaction between atoms. It is impossible to say anything concrete about the shape of the electron when there is no interaction with the matter. Other experiments need to be performed, for example the ones involving the interaction of ring electrons with photons.

When the speed of the progressive motion of the free ring electron is equal to $\alpha^{3/2}c$ then its kinetic energy becomes equal to 0.1eV. The speed of travel of the ring electron $\alpha^{3/2}c$ is the critical speed of travel of the pseudo two-dimensional object in three dimensional space. When this speed is exceeded the electronic ring coils into a tree dimensional object – torus. When the energy increases the major diameter of the torus decreases while the small diameter increases. The increase of the small radius of the torus leads to the increase of the cross-section of interaction of the electron with atoms.

Macro-quantum effects in the condensed matter

Let us imagine that in certain material under certain critical temperature (energy) the electrons are ring electrons. Let us examine what is going to happen to the electronic rings in the condensed matter when they are united [4].

If the spins of the electrons are aligned in the same direction ↑↑↑↑↑… the magnetic field along the axis x of such electrons will be equivalent to the magnetic field of the magnetic coil. Such trains can exist in some solid bodies due to specifics of the lattice structure. The temperature under which the formation of the electron train in the material can be calculated in the following way

$$T_e = \frac{n_1}{n_2}\frac{\alpha m_e (\alpha c)^2}{2k} = \frac{n_1}{n_2}\cdot 1151.86K \qquad (10)$$

where n_1,n_2=1,2,3…etc. are quantum numbers connected with the structure of the material's lattice, k – Boltzmann constant. Such materials exist in nature. They are called materials with metal-semi-conductor phase transition materials.

It is generally known that metal compounds of phase transition metals have variable valence. Higher oxides of metals such as Ti, V, Nb, Mo, W when there are deviations in stoichiometry due to the lack of oxygen do not form point defects but they form new Magnelli homologous series: M_nO_{2n-1}, M_nO_{3n-1}, M_nO_{3n-2} , where n=1,2,3 ... etc. [13]. Besides, the said metals form compounds which have phase transitions metal-semiconductor under higher than normal temperatures. For example, NbO_2, T_k=1070K (797^0C); V_3O_5, T_k=450K (177^0C); Ti_2O_3,T_k=600K (327^0C); Ti_3O_5, T_k=448K (175^0C); ZrO_2, T_k=1273K (1000^0C). Consequently, it is extremely convenient to use such materials in nano-technologies. It is also possible to use other materials which have high temperature of transition metal-semiconductor: $MoTe_2$, T_k=1053K (780^0C); $FeSi_2$, T_k=1123K (850^0C).

When critical temperature is exceeded (10) additional current starts to run along the localized channels in the form of cords inside the material. For example, in VO_2 the temperature of phase transition according to (10) is equal to (8/27)·1151.86 K = 341.3K. Experimental quantity of the temperature of the transition is diffused around 340K. Hence we have theoretical value (1/8))·1151.86 K=144K and experimental value for and experimental value 145K *etc for* V_2O_3.

Generally accepted at present explanation of the effect of phase transition metal-semi-conductor is based on the assumption of melting of electronic Wigner crystals when the critical temperature is exceeded [13]. However this theory does not provide exact values of temperatures of phase transitions and it uses additional empirical coefficients across the board.

Thermal energy in our model is spent on the release of the electron from the lattice and on the build-up of spins of the ring electrons in one direction.

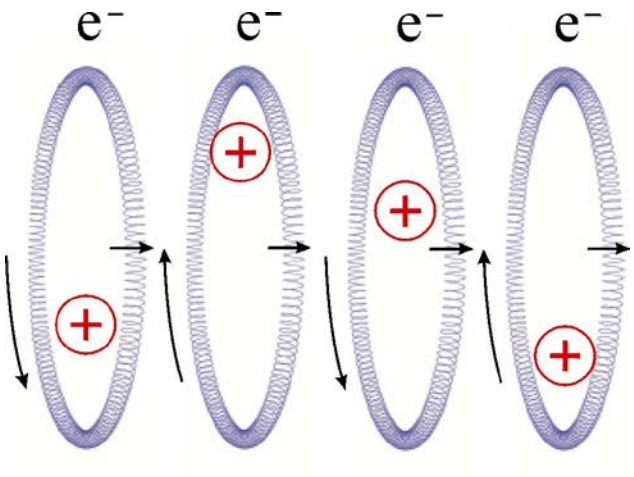

Fig. 3. Mechanism of formation of the high temperature superconductivity. Ions of the lattice are randomly located.

In a different situation when the spins of the ring electrons are turned in the opposite directions the trains of electrons looking like ↑↓↑↓↑↓…(pic.3) are formed. The critical temperature caused by the torsion of the spin π and compensation of their magnetic moments will decrease and will be equal to

$$T_e = \frac{n_1}{n_2}\frac{\alpha m_e (\alpha c)^2}{2k\pi} = \frac{n_1}{n_2}\cdot 366.65K \qquad (11)$$

Such state occurs in some materials, for example in high temperature superconductors. For instance we have theoretic value of the temperature of the phase transition metal-superconductor (1/4)·366.65*K* = 91.66 *K* and experimental value 91.6 *K* for a single crystal $YBa_2Cu_3O_7$. Such high coincidence can be achieved only when side factors are eliminated. In other words the experiment must be performed at low currents and in the absence of external magnetic fields [14].

It is extremely important to know that **one can practically obtain high-temperature superconductivity almost at the temperature of boiling water of 93.5^{0}C if one selects materials with n_1=n_2=1.**

As opposed to the materials with the phase transition of metal-semiconductor here we have a converse effect. The exceeding of the critical temperature (11) destroys the chain. This is caused by the fact that the number of free electrons in a volume unit of the semi-conductor must be limited in such a way so that their rings would overlap. When the temperature grows the number of free electrons increases and they start to dissipate on each other destroying the chains.

It is important to note that masses of ions of the lattice are missing in the formulas (10) and (11). Actually it follows out of the formulas that the ring electrons are practically impervious directly to the environment, they interact with the environment only indirectly through the concentration of free carriers. In other words, it can be said that the pairs of the ring electrons behave like neutrinos which do not have any charge.

In order to develop super-conductive materials apart from the knowledge of the electron structure one must know the structure of the fields of the lattice itself where the electron travels. In section 3 of this work we will demonstrate bonding between the structure of the atom fields and structure of the field of their nuclei. This bonding in current models of solid bodies is not taken into account that is why it prevents development of materials with desired/defined properties especially superconductive materials.

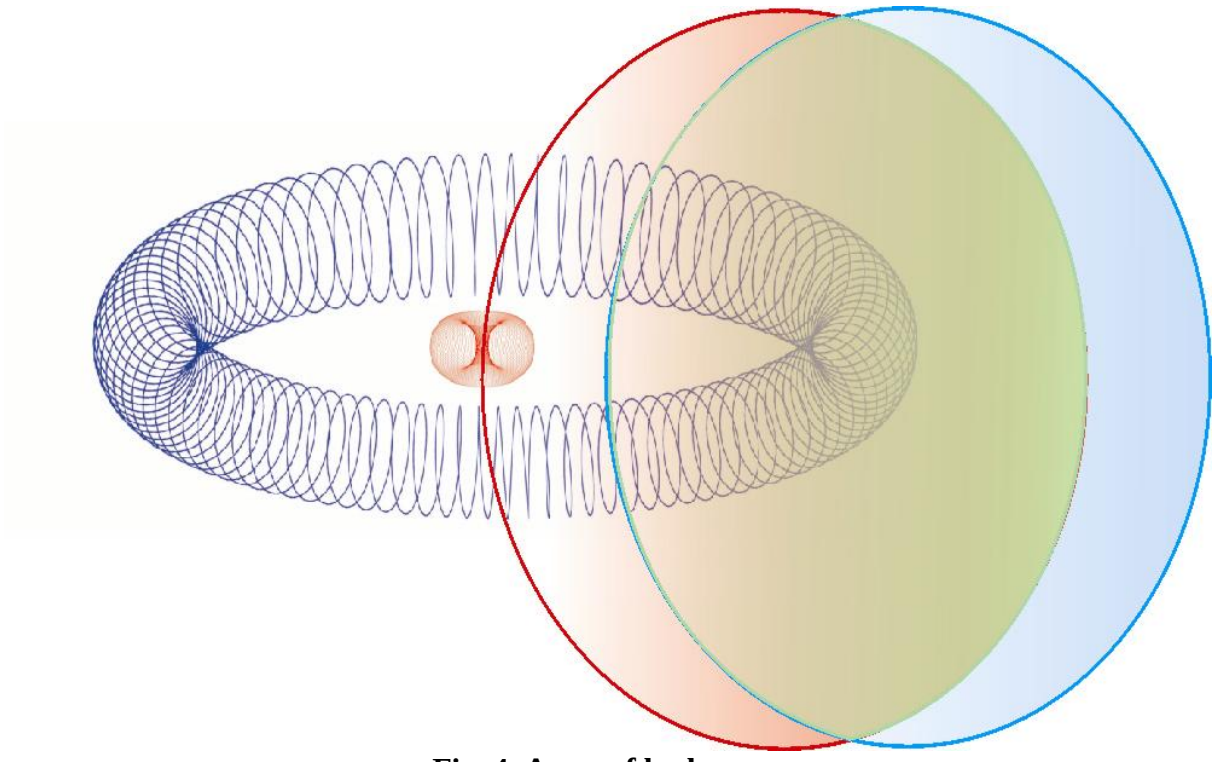

Fig. 4. Atom of hydrogen.
Here is one segment of the electromagnetic field of proton and electron.

Electrons in the atoms

Let us examine travel of free electrons in relation to positive ions. The simplest case is the system of hydrogen plasma. When the density of the hydrogen plasma is low stable pseudo-atoms of hydrogen are formed when the plasma cools down (degenerates), the size of the pseudo-atoms is 137 times bigger than a normal atom of hydrogen [15]. In our model the pseudo-atom can be represented as a system of ring electron and proton located in the center of the ring electron. Under the electromagnetic field effect of the proton such electron will tend to take new energy state by forming neutral hydrogen atom. Pic.4. At the same time the electrostatic field of the proton is compensated by the electrostatic field of the electron. One of 861 segments of the electrostatic field of the electron and proton is shown on picture 4. Let us examine what happens to the ring electron under such circumstances.

The only opportunity of spiraling of the electron to the size of atom is for the electron to coil into a spiral. Let us consider that it's the speed of the ring turning into the spiral (the speed of its travel towards the proton) equals to $\alpha^{-4}c$. Then the time of formation of the atom of hydrogen can be calculated according to the following formula:

$$\tau_0 = \frac{2\pi r_0}{\alpha^4 c} = 5{,}35961563 \cdot 10^{-8}\, s \qquad (12)$$

This value coincides with experimental assessments made for the overcooled plasma 10^{-8}C [15]. Accordingly the velocity of travel of the toroidal electron around the proton will rise 137 times and will become equal to $\alpha^{-}c$. Then the kinetic energy of travel of the toroidal electron around the nucleus will be:

$$V_\gamma = \frac{m_e (Z\alpha c)^2}{2e}\left(1+\frac{m_e}{M}\right)^{-1}\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right) \qquad (13)$$

Where M is the mass of the nucleus; n_1,n_2 are numbers of energy levels, Z is the charge of the nucleus. This formula fully coincides with the solution of the Bohr's equation for the point electron inside the hydrogen-like atom. As we can see, in such a case it is impossible to tell the point electron from the toroidal electron by means of the mechanical moment. But it follows out of the Bohr's model that the condition of quantization of the moment of quantity of motion comes out proportional to h. However the experiment yields the value of $h/2\pi$. Sommerfeld's attempt to obviate the contradiction by integrating the motion of the electron along the whole of the orbit lacks physical substance.

In our model like in the Nicholson's model the said contradiction disappears automatically since the continuous ring always possesses a quantization step proportional to $h/2\pi$. Besides, totally new quality in principle emerges in our model. In our model the system electron-proton is not dipole and consequently it does no emit electromagnetic waves. One of the drawbacks of the Nicholson's model is the fact that the electron ring the size of an atom in his model oscillates in plane and this prevents from describing the processes of radiation/absorption of photons. Besides, Nicholson's model of the ring electron does not make it possible to describe the shift of the spectrum corresponding to the reduced mass of the electron and proton.

At present quantum mechanics and quantum electrodynamics also do not make it possible to explain the most important mechanism going on in the atom: how photons are emitted and absorbed. For instance quantum electrodynamics purely formally demonstrates what the photon will emit during the shift.

According to the experiments exploring the diffusion of gaseous hydrogen and the cross-section of interaction the excited atom does not exceed its size. However all generally accepted theories maintain that the size of the excited atom is proportional to n^2.

It follows out of the experiment that minimally possible length of the wave of the photon emitted by the atom of hydrogen is equal to 88.2 nm (the energy of ionization is equal to 13.6V). The diameter of the atom of hydrogen itself is equal to only 0.1056 nm. If we assume that the

electric dipole the size of 0.1056 nm or magnetic dipole the area of πr^2 are the emitters, then the effectiveness of their emission will be -

$$\sigma_e = \frac{Z_e}{Z_0} \approx \left(\frac{2r}{\lambda}\right)^2 = 1.3 \cdot 10^{-6} \quad (14)$$

$$\sigma_m = \frac{Z_m}{Z_0} \approx \left(\frac{\pi r^2}{\lambda^2}\right)^2 = 1.11 \cdot 10^{-12} \quad (15)$$

where Z_e , Z_m and Z_o are wave resistances of the electric, magnetic dipoles and of the vacuum respectively.

According to classic electrodynamics the effectiveness of such antennae will be 10^{-6} - 10^{-12}. When the length of the wave is increased the effectiveness of such emissions decreases. For example, during hyperfine radiation the length of the wave increases by α^{-3} times and amounts to 21.1 cm, so the effectiveness of the emitter will be $2 \cdot 10^{-19}$ for the electric dipole and $2.5 \cdot 10^{-38}$ for the magnetic dipole.

This paradox is circumvented with the help of a postulate which maintains that the electron is emitted or absorbed with effectiveness equal to 1.

Let us examine the mechanism of radiation/emission of photons on the basis of our model.

In order to explore photon with the effectiveness equal to 1 it is necessary that the size of the emitter to be equal to one-half of the length of the emitted wavelength, i.e. it should be a half-wave vibrator. Then the length for such emitter for the atom of hydrogen should be equal to no less than 45.56328 nm.

The process of the emission can be well described in our model in the following way. When the photon is absorbed by the atom a deformation of the torus-ring into the torus-ellipse occurs. In this case the nucleus shifts to the focus of the ellipse of the torus and the emitting dipole is formed. This dipole makes one revolution of perihelion, emits excessive energy in the form of photon and returns to its stable state by taking a ring shape. In this case reduced mass of the electron and proton is taken into account by a natural way. The main part is played by electron's electromagnetic mass αm_e rather than the electron itself in this process of radiation/emission. The electromagnetic mass of the electron rotates together with the toroid electron itself and forms a torus with a large radius (picture 3). In the case of the atom of hydrogen when the electron takes the upper energy state the radius of the electromagnetic mass is equal to r_0. The radius of the electromagnetic mass will be lower at lesser energies of the electron. It results in the electron and its electromagnetic mass forming a system of embedded segmented tori and the revolution velocity of the radius-vector within the limit of r_0 is equal to the speed of light. Then the length of the perimeter of the torus-like emitter is equal to

$$\lambda_k = \frac{h}{m_e \alpha^{k+2} c} \ . \quad (16)$$

It follows that the length of the antennae for the atom of hydrogen is equal to 45.56388 nm.

In case of long-wave range the next layers of the electromagnetic mass are the emitters, for infrared radiation k=2. The most long-wave radiation corresponds to hyperfine radiation at k=3, λ_3= 0.11725 м. One can obtain such radiation when the length of the free path of the excited atom of hydrogen exceeds λ_3. It is this type of conditions which are selected in hydrogen maser clock.

Consequently the effectiveness of the radiation/absorption of the forming antennae in our model is equal to one.

In hydrogen-like atoms ($l \neq 0$) the electron veers in relation to the center of the nucleus which entails additional degree of revolution of the perihelion of the electronic ellipse. This leads

to the fine fission of the spectral lines. Mathematically it looks like Sommerfeld's solution which takes into consideration the relativistic correction to the motion of the electron around the elliptical orbit. However in our case there is no instability within the system because in our case it is the ring which moves rather than the point.

The presence of electromagnetic mass with large radius is corroborated experimentally by the effect concentration quenching of luminescence. This occurs when the gap between the luminescent centers becomes less than the radius of the electromagnetic mass corresponding to the length of the wave of emission.

New experimental data concerning the propagation of light in the rare medium also speak in favor of existence of electromagnetic mass of outer-shell electrons. For example, when the photon is being absorbed by the atom of the same wavelength as the emitted photon, it sort of freezes itself into the electromagnetic mass of the atom till the subsequent moment of emission. This effect is readily evident in the pairs of alkaline metals as the effect of "light stoppage" [16]. For instance the speed of propagation of light in sodium vapor at temperature close to 0 K is about 17 m/sec. If the average separation between the atoms does not exceed the size of the excited atom, i.e. the atom's electromagnetic mass, then it can precipitate domino effect – when the excitation is successively passed on from atom to atom when they collide. This is the phenomenon which causes the slow-down of the speed of propagation of light.

«Hot» electron in vacuum

Let us come back to examining motion of the free electron in vacuum at high energies from 10 kilo eV to 1 tera eV.

During experiments on dissipation of high energy (>1 GeV) electrons on the protons, the electrons behave in a very strange way like a structure-less point element. Experience shows that this is correct up to distance of 10^{-17} м, which does not correspond to Broglie electron wavelength at such energies. In the experiments concerning dissipation of photons (10-100 keV) on free electrons and electrons in the atom, the electron has a typical size of $2\pi r_c=2.426\cdot10^{-12}$ м, which is connected with Compton's wavelength. In order to explain this phenomenon the "naked" electron itself is represented in the shape of a point object having the size less than 10^{-17} м, and a certain form-factor is being ascribed to it which characterizes spatial distribution of the electric charge in the form of a cloud of virtual particles. This cloud has Compton's radius $r_c=\alpha^2 r_0.= 3.86\cdot10^{-13}$м.

In experiments dealing with dissipation of electrons (>1 кэВ) on protons, a new specific size of the electron shapes up, the size being called new classic radius of the electron $r_e=\alpha r_c=2.817\ 94\cdot10^{-15}$м. It should be noted that this size does not depend on electron's energy. It is a distinctive constant for the electron. It should be underscored that at this size according to general knowledge all mass of the electron is electromagnetic, in other words the electron as a real physical object does not exist – there is only a spatial "hole". Neither the "naked" electron the size of 10^{-17} м exists as well.

I.e. the electron reveals its different structure with corresponding specific size in different experiment.

Because of that all present theories cannot characterize electron from unified point of view.

The suggested model of electron makes it possible to describe contradictory pattern of behavior of the electron during various experiments.

As was stated earlier the velocity of travel of ring electron $\alpha^{3/2}c$ is critical. When this velocity is exceeded the electron ring coils into a three-dimensional object – hollow torus. When the energy is increased the major diameter decreases while minor diameter increases.

At the energies in the area of 500 keV major radius of the torus decreases to the size of $r_c=\alpha^2 r_0$. This radius can be experimentally deduced out of Compton dissipation of gamma quanta on electrons. Minor radius of the torus will be equal to $(1-\alpha)r_c$. (picture 5). Then electrostatic potential well with the radius of $r_e=\alpha r_c$ is being formed in the center of the torus. Its size completely coincides with the classic radius of the electron which can be experimentally deduced out of the dissipation of electrons on electrons. In other words the photons interact with the torus itself while the electrons interact with the potential energy well in the center of the torus.

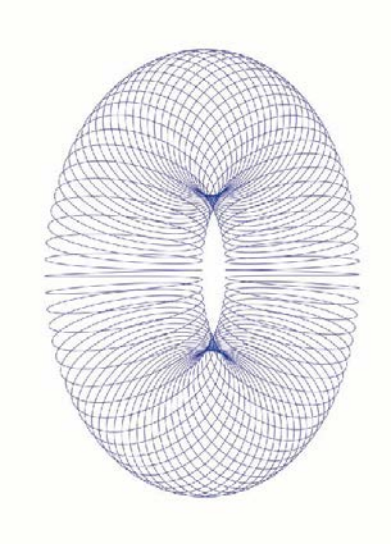

Fig.5. Relativistic electron.

Let us elaborate now why during dissipation of the electrons on protons the notion of the "naked" electron appears. Let us deduce minimal thickness of the ector (electron ring, picture 1a) or the thickness of a segment, a "petal" of the electrostatic field of the electron. Let us consider that the segments of the field close in between each other on the internal radius of the torus which limits its potential energy well. It follows than that the thickness of the segment can be defined in the following way:

$$d_e = 2\pi\, r_e / N_\alpha = \frac{\alpha h}{861 m_e c} \approx \frac{\alpha^2 \hbar}{m_e c} = 2.05 \cdot 10^{-17}\ \text{м}. \qquad (17)$$

This value corresponds to the limiting dimensions which are experimentally defined during dissipation of electrons on protons at ultimate experimental energies on accelerators. In such experiments the solid portion of the protons against which the electrons are dissipated amounts to $2\ 10^{-17}$м. It follows out our calculations that only one segment of the electrostatic field of the electron the size of $2{,}05\ 10^{-17}$м interacts with the solid portion of protons. Besides, extreme minimal dimensions of weak interaction inside the nucleus correspond to these dimensions. Consequently the structure of the nuclei also stratified. We will dwell upon this problem when analyzing the structure of nuclei.

Hence our model describes all the experiments concerning the dissipation of electrons.

Now let us examine what happens to the electron during its acceleration. It follows out of classic electrodynamics that when the electron accelerates in the electric field it should emit electromagnetic waves. However if we review vacuum electronic diode where the acceleration of electrons occurs during their travel from cathode to anode then we will not discover any radiation of electromagnetic waves. The radiation occurs only during the deceleration of the electrons on the anode – deceleration radiation. It should be noted that such radiation also occurs during the deceleration of electrons by electric or magnetic fields, for example, cyclotron radiation. Usually this paradox is not pointed out because it contradicts classic electrodynamics [Р. Пайерлс. Сюрпризы в теоретической физике. М. Наука. 1988].

The exploration of the dynamics of motion of the free electron in space leads to another paradox. For instance, according to special theory of relativity the force **F** affecting the electron is equal to:

$$\mathbf{F} = \frac{d}{dt}\left(\frac{m_e \mathbf{v}}{\sqrt{1-\beta^2}}\right), \qquad (18)$$

where $\beta=v/c$, and **v** – velocity of motion of the electron in space (here and hereinafter vector values are highlighted in bold type). If force **F** acts in the direction of motion of the particle then the mass of the electron increases due to the relativistic effect and it will be equal to:

$$m_{//} = m_e\left(1-\beta^2\right)^{-3/2}. \quad (19)$$

This mass is named longitudinal mass. It measures the inertia of a particle in the direction of its motion. As for the force acting perpendicularly to the motion of the particle, the mass of the electron becomes equal to:

$$m_{\perp} = m_e\left(1-\beta^2\right)^{-1/2}. \quad (20)$$

This mass is named transverse mass. It is measure of inertia of the particle in the direction perpendicular to its motion.

Dependence of transverse and longitudinal masses on the velocity is the same, it differs by the value:

$$\delta m = m_{//} - m_{\perp} = m_e\beta^2\left(1-\beta^2\right)^{-3/2}. \quad (21)$$

It follows out of the formula above (21) that the mass of the particle is anisotropic.

In experiments where the accelerating field is applied parallel to the direction of motion of the particle we are to witness the dependence (19), i.e. the particle is to accumulate energy. In reality we observe that it is sort of affected by the transverse force (20), i.e. it gains energy according to the law (20) which contradicts the theory. Besides it is experimentally established that the particles themselves travel along the vectors of the parallel field and they do not have a transverse shift.

Kaufmann ((W. Kaufmann) (1906) [17]) put an experiment to define the specific charge of the electron e/m_e. He established experimentally that high speed electrons moving in the transverse field $E_{\perp}$ at a speed $v_{//}$, start traveling in plane x,y along the parabola.

$$x = \frac{eE_{\perp}}{m_{\perp}}\cdot\frac{l^2}{2v_{//}^2} = \frac{E_{\perp}l^2}{2v_{//}^2}\frac{e}{m_e}\sqrt{1-\frac{v_{//}^2}{c^2}} \quad (22)$$

$$y = \frac{eH_{\perp}}{m_{\perp}}\cdot\frac{l^2}{2cv_{//}} = \frac{H_{\perp}l^2}{2cv_{//}}\frac{e}{m_e}\sqrt{1-\frac{v_{//}^2}{c^2}} \quad (23)$$

It seemed that Kaufmann experiment was a triumph of the specific theory of relativity since it confirmed the relativistic increase of mass depending on the increase of velocity. However, as it is evident from (22), (23), the motion of the electron in the transverse electric field occurs without the increase of kinetic energy. The change of the mass depends only on the initial velocity of motion of the electron $v_{//}$. It follows then that the equation (20) in this case contradicts Kaufmann's experiment. As it follows out of (22),(23) one cannot physically separate charge and mass of the electron e/m_e. That is why one can interpret Kaufmann's experiment as relativistic decrease of the charge rather than increase of its mass!

In our model the toroidal electron travelling in the accelerating potential electric field will gain energy due to the transverse force affecting it. This force will spin the electron around its axis by affecting the segments (petals) of the electron field. It can be visually represented as rotation of a turbine by means of air flow pushing the turbine's blades. In case of the toroidal electron the role of the blades is performed by the electromagnetic mass which is represented by a superposition consisting of 861 petals. Consequently, accumulation of energy by the electron during its acceleration occurs thanks to the increase of the velocity of the revolution of the torus rather than relativistic increase of its mass. The increase of the energy of the electron results in the compression of the electromagnetic mass, i.e. decrease of the size of the petals. Hereby during the acceleration of the electron it absorbs energy, consequently the electron does not radiate. During the slow-down of the electron its electromagnetic mass expands and radiates accumulated energy in the form of photons. As far as we can see, our model elementary solves these two paradoxes – the absence of radiation during the linear acceleration of the electron and the transformation of the transverse force of the accelerating field into kinetic energy (mass) of the electron.

During the increase of the energy of the electron in the accelerating field the simultaneous decrease of major and minor radii of the electronic torus occurs. At the same time the size of the hole in the center of the torus remains constant and equal to the classic radius of the electron. As result a moment comes when the electron turns into a fine ring with the radius of r_e and stops interacting with the accelerating electromagnetic field. This effect is experimentally observed as disruption of the energy spectrum of the cosmic electrons at the energy of 10^{12} эВ. Our calculation yields critical value:

$$V_e = \alpha \frac{m_e}{e}\left(\frac{c}{\alpha^2}\right)^2 = 1.3 \cdot 10^{12} V . \qquad (24)$$

It should be noted that according to (9), (24), the processes of coiling of the electron into torus occur within the following speed range: from speed of the progressive motion of the electron $c\alpha^{3/2}$ till speed of torsion of the torus $c\alpha^{-3/2}$. Here the speed of the progressive motion does not exceed the speed of light. The electron itself transforms from the ring the size of $r_0 = \alpha^3 r_e$ into the ring the size of r_e.

In this case the specific theory of relativity leads to a new paradox – there is no limitation of the increase of energy of the electron in the accelerating field in the theory. But the experiment demonstrates quite the opposite – the existence of the limit. We have solved this paradox of the specific theory of relativity as well.

We will review problems of the relativistic electron and involved effects in our further publications.

Electron clusters

Let us examine behavior of groups of ring electrons in vacuum.

If high pulse voltage is applied in between two metal bars it may cause explosive electron emission into the vacuum, for example as in experiments performed by Mesiats et al. [18] or as in experiments [19]. Let us comment on this experiment.

If electron concentration in the unit of volume is sufficiently high the electrons can form trains with parallel or anti-parallel spins directly in the vacuum. Since the ends of the trains may have excessive energy such trains may bind into rings during fluctuations. Such rings in their turn may form new trains due to the fact that there are always potential magnetic ring wells at the end of the trains like the single potential well in the ring electron.

The electromagnetic mass of the electron will concentrate in the area with the following radius

$$r_2 = \frac{\hbar}{\alpha\, m_e \alpha^2 c} = 0.9937 \cdot 10^{-6}\ \text{м} . \qquad (25)$$

Interacting with each other by means of this electromagnetic mass the ring electrons can for cluster with the diameter of up to 2 micron. The number of electrons in such a cluster can reach up to $2\alpha^{-3}$, i.e. around 5 million electrons. Such cluster is a very stable formation. It got the name of ecton [18]. Picture 6.

Bigger clusters with the diameter around 50 micron are formed by the explosive emission of electrons into vacuum from the metal apex which is located close to the surface of the dielectric [19]. The number of electrons in such clusters may reach up to 10 billion. Formation of such a cluster – super-ecton out of ecton can occur by expansion of coverage of the electromagnetic mass directly of the ecton itself and the coverage will be concentrated in the area with the following radius:

$$r_2 = \frac{\hbar}{m_e \alpha^4 c} = 1.284 \cdot 10^{-4}\ \text{м} . \qquad (26)$$

According to the main electrostatics theorem of Earnshaw the formation of the clusters out of like charges is not feasible due to effect of the repelling forces. However this theorem was proven for the Law of Coulon which has spherical symmetry. In our case the field of the electron is segmented and has toroidal symmetry. This creates spatial anisotropy of the surrounding field. It is because of this anisotropy it becomes possible to unite like charges into the electronic cluster.

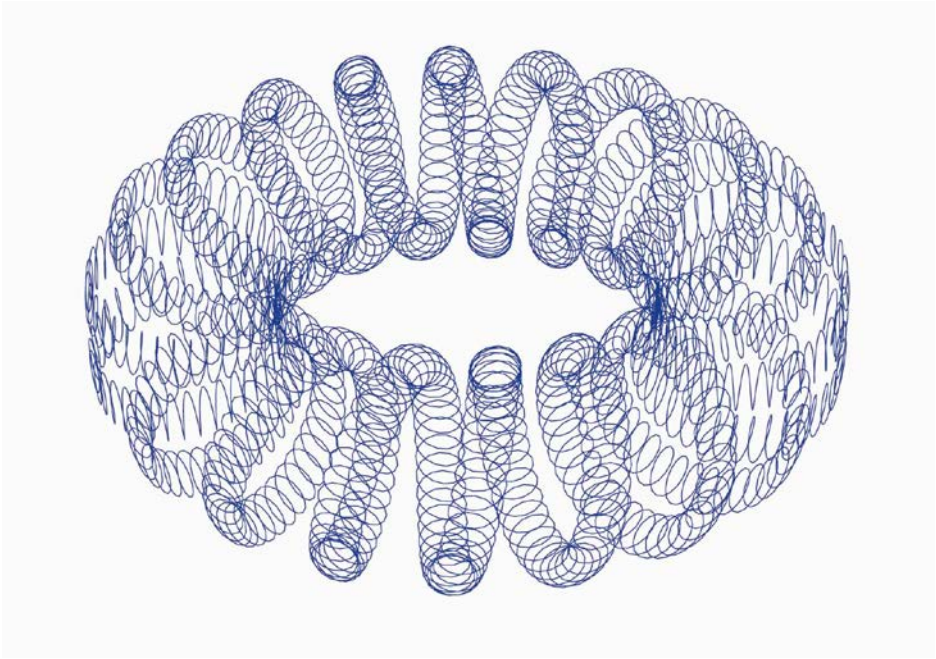

Fig.6. Electronic cluster consisting of one billion electrons with the diameter of 50 micron.

On the basis of the suggested model we have calculated the most sophisticated physical effects. First and foremost it is critical parameters of phase transitions of the matter including the phase transition metal-semiconductor, metal-superconductor, semi-conductor-superconductor [4]. The most important formulas are listed in the Table below.

Table. The list of formulas concerning macro-quantum effects in the condensed matter

N	**Name**	**Theoretic formula**	**Theoretic quantity**	**Experimental quantity**	**Literature**
		Author		***Independent experiment***	
<u>Low temperature superconductivity</u>					
1.	Critical temperature of superconductivity in fine metals	$T_c = \frac{M_i v_c^2}{2k}$			
2.	Minimal critical temperature of superconductivity in fine metals	$T_c = \frac{M_i(\alpha^4 c)^2}{4k}$	$5.32 \cdot 10^{-4}$K	$5 \cdot 10^{-4}$K (Mg)	20
3.	Max. Speed of light in metals	$v_s = \frac{3\alpha^2 c}{\sqrt{4\pi}}$	$1.3509 \cdot 10^4$ м/s	$1.341 \cdot 10^4$ м/с (in Be along crystalline axis L_{001})	21

4.	Critical velocity of motion of electrons in Be which participate in superconductivity	$v_c = \frac{3\alpha^3 c}{\sqrt{2\pi}}$	139.43 м/s		22
5.	Max. Critical temperature of superconductivity in fine metals	$T_c = \frac{M_i}{2k}\left(\frac{3\alpha^3 c}{\sqrt{2\pi}}\right)^2$	10.598K	10.5K (in films of Be ≤3 нм),	22
<u>High temperature superconductivity</u>					
6.	Critical temperature of high temperature superconductivity	$T_c = \frac{m_e^* v_c^2}{2k} = \frac{m_e(\alpha^2 c)^2}{2\pi n\alpha k}$ $m_e^* = 2m_e\alpha^{-1}$, n = 1,2,3 …			4
7.	Max. Possible critical temperature in superconductors	n=1	T_{c1}= 366.65K (93.5^{0}C)	365K (92^{0}C) , powder-like superconductors on the basis of xCuBr.$CuBr_2$	4, 23, 24, 25, 26
8.		n=2	n=2, T_{c2}=183.2K (-89.95^{0}C)	185K (-88^{0}C) powders on the basis of the system of C_{60}/Cu with the ratio of 7/1	27
9.		n=4	T_{c4}=91.66K (-181.49^{0}C)	91.6K (-181.55^{0}C) superconductors of the type of $YBa_2Cu_3O_7$	28
10.		n=16	T_{c16}=22.92K (-250.23^{0}C)	T_c= 23.2 ± 0.2K (-250.15^{0}C) 200 nm film Nb_3Ge	20
11.		n=32	T_{c32}=11.46K (-261.69^{0}C)	Does not exceed in superconductors of the second type of gender Y_2C_3, NbC, Nb_3Au	20
12.	Max. Possible frequency of transmission of electromagnetic waves via high temperature superconductors	$f_e = \alpha^2 c / 2\pi r_0 = m_e(\alpha^2 c)^2/h$	$3.5037\cdot10^{11}$ Hz		4
13.	Ultimate density of current per 1см^2 of the plane of the high temperature superconductor	$j_e = ef_e / (\pi r_0^2) = (4\pi e m_e^3\alpha^8 c^4)/ h^3$	$3.4 \cdot 10^4$ А/см^2		4
14.	Critical magnetic field in high temperature superconductors	$B_e = 2\pi f_e m_e / e = (2\pi m_e^2\alpha^4 c^2)/(e h)$	12.5 tesla		4

15.	Critical magnetic flux in high temperature superconductors	$\Phi_e=\pi r_0^2 B_e=h/2e$	$2.0678\cdot10^{-15}$ weber		4

* The table is quoted from publication http://arxiv.org/ftp/physics/papers/0111/0111182.pdf [29]

Hereby α - fine structure constant; e – electron charge; $\hbar = \frac{h}{2\pi}$ – Planck constant; c – speed of light; M_i – ion mass of the lattice; m_e – electron mass; k – Boltzmann constant; m_e/α - heavy mass of electron.

Additional data on low temperature superconductivity is quoted in the table for comparison purposes. By comparing parameters of low temperature and high temperature superconductivity one can see that parameters of low temperature superconductivity are connected with the mass of ions of the lattice while parameters of high temperature superconductivity are connected with kinetic energy of electron only – with the temperature of the lattice.

Since only high temperature superconductivity has practical application all critical parameters were calculated for the high temperature superconductivity, namely: temperature, currents, magnetic field, magnetic flux. Maximum possible frequency of transmitting signal was calculated for superconducting wires which have performance standards exceeding the ones of optical fibers.

Conclusions

1. Generally accepted at present models of Bohr, Schredinger and Dirac based on structure-less point model of electron which ignore the electromagnetic mass contradict fundamental laws of physics.
2. Model of the ring electron makes it possible to describe from the unified point of view the size of the electron, its mass, electromagnetic mass, spin, magnetic moment.
3. The model of “cold” electron explains from the new point of view critical temperatures of phase transitions in the matter including phase transition metal-semiconductor (Winner crystallization0, low temperature superconductivity metal-superconductor and high temperature superconductivity semiconductor-superconductor for the condensed matter. It is demonstrated that the parameters of low temperature superconductivity correlate with the mass of ions of the lattice while parameters of high temperature superconductivity correlate only with kinetic energy of the electron – temperature of the lattice.
4. As far as steadily moving “hot” electrons are concerned the ring electron transforms into torus which makes it possible to describe the change of the cross-section of interaction with the gas – Rammsauer effect.
5. The model of the ring electron transformed into torus makes it possible to reconstruct atom of hydrogen, describe energy states of the atom including its spectrum, radiation and absorption process, the size of the atom and its stability.
6. The model of the electron explains from the unified point of view experiments regarding dissipation of electrons up against electrons, photons on electrons and electrons on protons.
7. The model of the toroidal electron makes it possible to explain the paradox of absence of electron radiation in linear accelerating field.
8. As far as the relativistic electron is concerned the model of the toroidal electron explains the changes of the cross-section of interaction with the accelerating electromagnetic wave till the complete disappearance of the interaction – the disruption in the energy spectrum of the cosmic/interstellar electrons.

The model of fundamental elementary particle is submitted in the present work which is called **ector** (electromagnetic torus). The foundation of this model is fine elastic ring with the radius which is r_0 в α^{-1}=137,0360547255...times bigger than Bohr's radius of hydrogen which consists of specific form of electromagnetic field.

On the basis of such model the "cold" electron (<0,1эВ) is represented in the shape of a ring with the radius $r_{0,}$ where mass m_e is evenly spread along it and the charge e. The revolution of the ring around the central axis with the velocity $\alpha^2 c$ describes kinetic energy of the electron which determines the mass. The coiling of the ring creates the charge of the electron with the direction of the coiling with respect to the torsion of the electron as a single whole creates the sign of the charge, i.e. electron or positron. During the rotation the number of full revolutions is limited by the number 861 and the number is determined by the constant of the fine structure α.

Hence the electromagnetic field of the electron does not look like continuous 3-D field it looks rather like a composition of N_α planes having the shape of round petals. In other words the electron field is segmented.

The transverse revolution of the central axis in relation to the plane of the ring determines the spin of the electron $J = \hbar/2$ and its magnetic moment. The anomalous moment of the electron is modeled by the separation between the petals of the electromagnetic field.

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