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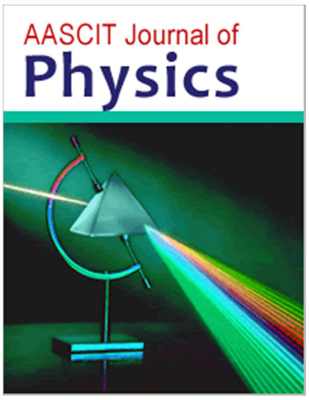

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Liquid-Drop Model of Electron and Atom

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Abstract
In the article is examined the liquid-drop model of electron and atom, which assumes existence of electron both in the form the ball-shaped formation and in the form liquid. This model is built on the same principles, on which was built the liquid-drop model of nucleus, proposed by Bohr and Weizsacker.

1. Introduction

Phenomenon of the electrization of dielectrics known long ago. With the friction the dielectrics acquire booster charge, in this case the electrons pass from the dielectrics with the smaller dielectric constant to the dielectric, whose dielectric constant is more. Millikan established that with the dispersion in air of oil of his drop the discrete charges acquire. This made it possible to make the conclusion that the charges can have only discrete variable and the measured discrete magnitude of the charge of drops was defined as electron charge. Experience does not give the possibility to establish, from where drops obtained discrete charges. These charges could be obtained with the transformation of oil into the drops in the process of its dispersion. The discrete charge of drop they could obtain also with interaction with the nozzle of atomized-spray injector, or in the process of interaction with atmospheric air. In air be contained to always vapors of water, and since the dielectric constant of water is great, i.e. molecules could take away charges in the drops of oil. As a result these experiments electron they began to consider ball-shaped formation with the specific sizes and discrete charge.

Since it was established that the electron has discrete charge and has ball-shaped form, became a question about the special features of its presence in the constitution of atom. The idea of the Bohr orbits of electron in the atom thus was born. This idea assumes that the electrons revolve around the positively charged nucleus, being found in specific orbits. Passage from one orbit to another is accompanied by the emission of the quanta of the electromagnetic radiation, when each quantum bears the specific bundle of energy. These assumptions became the basis of quantum mechanics. But in this model there exist the contradictions, which are not removed to the these rapids. With its electron motion must continuously emit electromagnetic waves, but, moving in the constitution of atom, it does not emit. In addition to this the simplest atom of hydrogen, which consists of the proton and the electron revolving around it, must have magnetic moment, but hydrogen atom of this moment does not have. We must conclude for this reason that the physically substantiated model of the simplest atom, which is hydrogen atom, until there exists.

But problems are located not only with electron and atom of hydrogen. Is not clear nature of structure and proton, or complex nuclei, in which act nuclear forces. It proposed the liquid-drop model of nuclear structure in 1936 n. Boron in order to explain the long times of life of the excited nuclei of the heavy elements, the generatrix during capture of the slow neutrons of [1,2]. It developed Weizsacker, considering nucleus as the spherical drop of incompressible charged nuclear fluid [3,4]. The proposed model had large haste, and with its aid it was possible to explain many properties of nuclei and to, in the first place, obtain semi-empirical formula for the nuclear binding energy.

In this article we will attempt to build the liquid-drop model of electron and atom.

2. The Liquid-Drop Model of Electron and Atom

Electron can be found in the bound state in the constitution of atom, and also in the free state in the form of electron beams or near the incandescent cathode in the electronic devices. In the free state electron to be found also in the conductors, when it can freely be moved into the tele-conductor. But if we consider electron the ball-shaped formation of the specific sizes, then problems here appear. In the superconductive state the depth of penetration of magnetic pour on and currents composes values the strand of several hundred angstroms, while the value of the surface roughness it is measured by microns. The electron velocity in superconductive niobium with the critical magnetic field is about 300 m/s. If electron was ball, then moving along so twisting a trajectory, it due to the inertial forces would destroy surface, but this it does not occur. Therefore possible being to assume that located in the composition of conductors, electrons present liquid, and they move according to its laws. When conductor they heat to the high temperature, this liquid similar to water vapor evaporates from the surface of conductor. After exceeding the limits of conductor, vapors of this liquid are condensed into the drops, forming electrons.

Liquid has the surface tension, because of which the drop of liquid acquires ball-shaped form. In this case internally the pressure in the drop is created by the forces of surface tension, which act on the surface.

The pressure, created by the surface of drop is determined by the relationship

$$p_\sigma = \frac{2\sigma}{r} \tag{2.1}$$

where σ is coefficient of surface tension, r is radius of drop.

Laplace proposed this formula.

The electron is had the external electric field, which attempts to tear electron, these force pour on in the direction they are reverse to the forces of surface tension. Their pressure on the surface of electron is determined by the relationship

$$p_E = \frac{1}{2}\varepsilon_0 E_s^2 \tag{2.2}$$

where E_s is tension of electrical pour on the surface of electron.

The tension of electrical pour on the surface of electron it is determined by the relationship

$$E_s = \frac{e^2}{32\pi^2\varepsilon_0 r_e} \tag{2.3}$$

where e is electron charge, ε_0 is the dielectric constant of vacuum, r_e is a radius of electron.

Equalizing relationships (2.1) and (2.2) and taking into account relationship (2.3) we obtain the coefficient of surface tension for the electronic liquid

$$\sigma_e = \frac{e^2}{64\pi^2\varepsilon_0 r_e^3}$$

Substituting in relationship (2.4) tabulated data, we obtain

$$\sigma_e = 2\cdot 10^{11}\ \frac{N}{m}.$$

For the comparison let us point out that for the water the value of surface tension composes 0, 073 N/m, while for mercury it is equal to 0,487 N/m.

A classical radius of electron composes $2.8\text{x}10^{-15}$ m. From the of experimental of data of from of the e - p of scattering of data and Hydrogen of spectroscopy follows that a radius of proton composes $9\text{x}10^{-16}$ m.

If we attempt ourselves to place proton inside the electron, then the fields of proton neutralize the charge of electronic liquid, after converting it into the usual badly compressible liquid. Volumetric drop will begin to be enlarged, being converted into the shell (Fig. 1) [5]. This shell will be extended until sets in the equilibrium between the electric forces, which attempt to press sphere and to the elastic forces of the electronic liquid, which prevent this compression. This process will determine the radius of the atom of hydrogen, which is equal $5.3\text{x}10^{-11}$ m. Since the charge of electronic liquid is equal to the charge of proton, electric fields outside the atom will be absent.

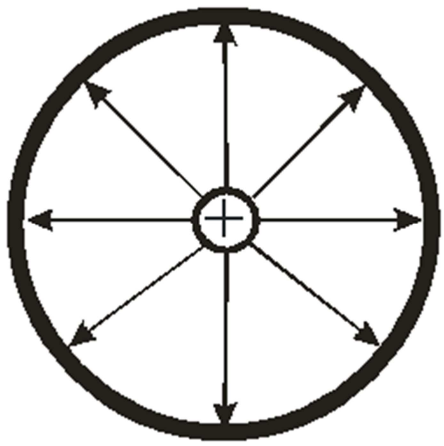

Fig. 1. *The liquid-drop model of atom.*

3. Conductivity of Metals and the Drop Theory of the Electron

Sufficient conductivity of normal metals extended by theory the model of the Drude appears. Electrons in the metal are considered as electron gas, to which it is possible to apply kinetic theory of gases. It is considered that the electrons, as the atoms of gas in the kinetic theory, are the identical solid spheres, which move along the straight lines until they encounter with each other. It is assumed that the duration of separate collision is negligible, and that between the atoms it acts no other forces, except the forces, which appear at the moment of collision. Since electron is negatively charged particle, then for observing the condition of electroneutrality in the solid body also must be the particles of another type, i.e., the positively charged ions. Drude assumed that the compensating positive charge belongs to the ions, which it considered fixed.

A simple scientific picture of the atom where the positive charge *e* of proton (or *Ze*) is located in the centre of the spherical homogenous distribution of negative charge *–e* (or *–Ze*) in order to calculate electrodynamics properties (polarization, conductivity) as well as other mechanical properties of the atoms (materials), may be today also taken as a clear and evident method (tool) on the phenomenological level, at least in the classroom of physics. In 1900 P. Drude already developed a useful model of electron gas of the free electrons in metals, based on the fact that metal could easily released 1, 2 or 3 valence electrons. Drude derived a relationship for the conductivity of metal on the assumption that electrons have same velocities according to thermal energy 3/2 kT. Lorentz (in 1905) improved the Drude's model by taking into account Maxwell-Boltzmann distribution of velocities. However, the relationship of conductivity remains unchanged despite numerical changes.

Despite the fact that gas density of conduction electrons is approximately 1000 times more than the density of classical gas at normal to temperature and pressure, in the the Drude's model the methods of the kinetic theory of the inert rarefied gases adapt. The basic assumptions of the Drude's model consist of the following:

In the interval between the collisions is not considered interaction of electron other electrons and ions even it is considered that each electron moves with the constant velocity along the straight line. Further, it is considered that in the presence of external pour on electron it moves in accordance with Newton's law. In the Drude's model, as in the kinetic theory, collisions are the instantaneous events, which suddenly change the electron velocity, and time between two sequential collisions τ is called relaxation time. This time enters into the relationship, which determines the conductivity of the metal

$$\sigma = \frac{ne^2\tau}{m}.$$

In this case the connection between the current density in the metal and the tension of electric field takes the form:

$$\vec{j} = \sigma\vec{E}$$

It is assumed that the electrons come into the state of thermal equilibrium with the lattice exclusively because of the collisions.

The Drude's model satisfactorily describes the phenomenon of the conductivity of metals and up to now successfully it is used in the electrodynamics.

The relation of conductivity of the metal can be also valid within the framework of quantum mechanics laws, by introducing electron effective mass *m** instead of standard mass *m*. By the concept of effective mass a specific features of moving electrons through the periodic potential can be correctly included. However, a definition of relaxation time will become little more sophisticated.

The conductivity of normal metals in the ac fields is characterized by the presence of the skin effect, when electrical and magnetic fields penetrate only to the specific depth. This phenomenon finds its explanation within the framework of Maxwell's equations. The depth of penetration δ_S and the surface resistance R_S are determined by the relationships:

$$\delta_S = \left(\frac{2}{\omega\mu_0\sigma}\right)^{\frac{1}{2}}, \quad R_S = \left(\frac{\omega\mu_0}{2\sigma}\right)^{\frac{1}{2}},$$

The drop theory, when electronic component in the metal is considered as electronic liquid, changes approach to the determination of the conductivity of metal. Task is converted into the hydrodynamic task along the flow around obstacles of the moving liquid. With the flow of the liquid about the fixed obstacles are two regimes: laminar and turbulent. For each form of flow there is critical Reynolds number Re_{cr}, which determines passage from the laminar flow to the turbulent. With the fulfillment of conditions of $\mathrm{Re} \le \mathrm{Re}_{cr}$ occurs laminar flow, with $\mathrm{Re} \ge \mathrm{Re}_{cr}$ in the liquid appear turbulences. With the laminar flow of liquid energy losses be absent, and, therefore, is absent resistance. In the turbulent regime, with the diffraction of obstacles in the liquid appear turbulences, which lead to the energy losses. Specifically, by this it is possible to explain the fact that even at temperatures, which are approached absolute zero, the end resistance is observed in metals. But if the obstacles streamlined with liquid accomplish oscillatory or other other motions, then this leads to additional turbulences, and, therefore, also to an increase in the resistance. And the greater the amplitude of the fluctuations of the streamlined obstacles, the greater turbulences, which leads to an increase in the resistance. This circumstance leads to the dependence of the resistance of metals on the temperature, since. with an increase in the temperature the amplitude of the oscillations of lattice ions increases.

The approach examined can be used for explaining this phenomenon as the superconductivity, which can be the consequence of the passage of the flow of electronic liquid from the turbulent to the laminar. Superconductors have the critical temperature, lower than which they convert to the superconductive state. This means that with the amplitudes of the oscillations of lattice ions of superconductor the laminar possible flow of electronic liquid is lower than the certain critical value. In the superconductors of the second kind there is a phase of the mixed state, when vortex formations can be created with the way of the imposition of external magnetic field. Vortex structures can have annular structure. Formations of the annular vortex structures, which appear due to the magnetic field, created by the magnetic fields of the currents, which flow through the superconductor. Abrikosov's vortices are formed during the imposition of external magnetic field. With the flow of electronic liquid these vortices begin to move, which leads to the appearance of resistance. The case, when in connection with the presence of the defects of crystal lattice, vortices are attached on such defects, is exponential, in this case the vortices cannot move, and resistance is absent. In the usual hydrodynamics this situation is realized be it cannot.

The liquid-drop model of atom examined transfers a question about the presence of resonances in the atom into the mechanical task. If there is an elastic shell, then it has the infinite number of mechanical resonances. These resonances can be to bear the axial nature, when standing wave has axial symmetry. Are possible also the resonances, when the integer of half-waves is plotted along the equator of sphere. But this system will possess still one type of the fluctuations, which generate the circularly polarized electromagnetic radiation. During the collision with other it will pass the displacement of electron shell on the relation to the nucleus as atoms. As a result this is formed the being varied and simultaneously revolving electric dipole. The emission of this dipole will be received by receiver as the emission of the specific frequency, modulated in the amplitude, and which, therefore, contains the carrier frequency and side frequencies. The totality of all resonances indicated and fluctuations of dipole will compose the emission of atom.

4. Conclusion

The proposed liquid-drop model of electron and atom this thus far only hypothesis, but it has right to existence as the liquid-drop model of nucleus. We attempted to describe only very idea of drop approach to the circumscription of electron, further development of these ideas in addition to of the liquid-drop model of nucleus can lead to the creation of the generalized liquid-drop model of atom.

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