MAGNETIC MODEL OF THE ATOM AND ITS APPLICATION IN MICROELECTRONICS

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The quantum model of the atom is now generally accepted. However, it does not explain a number of effects [1–4] and leads to theoretical paradoxes [5] and mathematical difficulties in calculating the spectra of many-electron atoms [6]. The formulas of quantum mechanics lead to divergences and infinities, for example, when analyzing the electron field and when taking into account zero-point vibrations in the spectrum in the form of energy $h\nu/2$, existing at any frequency ν and tending to infinity with increasing ν. That is, quantum physics leads to the same paradoxes that at the beginning of the 20th century, forced to abandon classical physics when analyzing the spectrum of thermal radiation and "ultraviolet catastrophe" - an infinite increase in energy in the high frequency region ν. Therefore, let us turn to the analysis of the classical magnetic model of the atom proposed by W. Ritz [7] and J.J. Thomson [8] at the beginning of the XX century. - simultaneously with quantum. This model explained the spectra and solved all the paradoxes of classical physics in the framework of classical mechanics [7, 9].

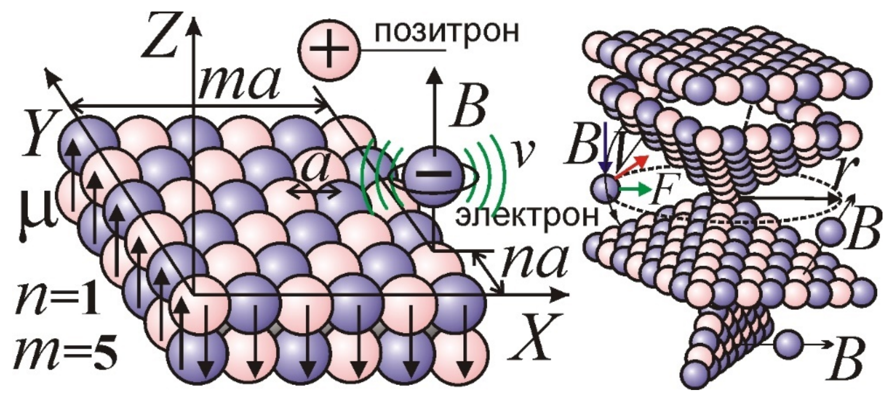

Fig. 1. Scheme of generation of the spectrum of the hydrogen atom and the structure of the atomic core.

According to the magnetic model of the atom, electrons occupy a number of stable positions-sites in the atomic core-nucleus (Fig. 1). Under external influences, electrons of mass M and charge e begin to rotate near equilibrium positions in the magnetic field B of the atom, emitting their rotation at the cyclotron frequency $\omega = eB/M$. A number of nodes (equilibrium positions of electrons) correspond to grid nodes of period a along the X and Y axes, for which the magnetic fields $B_1 = \mu\mu_0/2\pi r_0 y^2$ and $B_2 = \mu\mu_0/2\pi r_0 x^2$ are perpendicular to the grid plane and oppositely directed. Here μ is the magnetic moment of the electron, μ_0 is the magnetic constant, r_0 is the classical radius of the electron. Such a structure of sites and fields

$B = B_1 - B_2$ can be formed by chains of electrons and positrons, which form a semblance of a crystal lattice [9]. Contrary to Earnshaw's theorem, such systems of charges are stable at small deviations from the Coulomb law [8]. An example of such a flat lattice is graphene, where carbon atoms form a layer along which electrons move along the lattice sites.

Electrons vibrate only at frequencies corresponding to the magnetic field B at the sites. As shown by W. Ritz, this explains the line spectra of hydrogen and metals [7]. Thus, the spectrum of the hydrogen atom in the magnetic model is naturally obtained in the form of a set of frequencies $\omega = eB/M = (1/y^2 - 1/x^2)e\mu\mu_0/2\pi r_0 M$, where $x = ma$ and $y = na$ are the coordinates of the electron, and the period a is of the order of the size hydrogen atom ~10^{-10} m. Hence, the frequency spectrum of hydrogen $\nu = \omega/2\pi = Rc(1/n^2 - 1/m^2)$, where R is Rydberg's constant, c is the speed of light in vacuum, n and m are integers. The intensity of the spectral lines is determined by the degree of stability of the positions of the electrons at the sites. The more stable the site, the higher the percentage of atoms with electrons located in the corresponding sites and the higher the radiation intensity of the corresponding spectral line.

The magnetic model of the atom naturally explains the Zeeman and Stark effects [9, 10]. In the Stark effect, the electric field E displaces electrons from their equilibrium positions. According to the value of the field B' in the new position, the frequency $\omega' = eB'/M$ also changes. Depending on the arrangement of electrons in the atom, the dipole moments of atoms take on several possible values and directions with respect to the axis of the atomic core. Therefore, the external field, orienting the atoms, displaces electrons in different directions and to different degrees, which is why each spectral line is split into several, with similar frequencies and different directions of oscillations (polarization): this is the essence of the Stark effect [10]. This explains the experimental fact discovered by J. Stark: an inhomogeneous electric field divides the flow of atoms into several flows, depending on the magnitude of the dipole moment, and each flow emits only one spectral component [10]. In accordance with the magnetic atomic model, and contrary to the quantum one, the line intensity depends on the direction of the field E to the velocity vector of the beam of atoms.

The Zeeman effect was explained by Ritz by the imposition of an external field ΔB on the intra-atomic field B [7]. In the new field $B' = B \pm \Delta B\sin\theta$, the electron oscillation frequencies $\omega' = eB'/M$ change. Because the magnetic moment of atoms is codirectional with $\mathbf{\Delta B}$ and is oriented, depending on the placement of electrons, at different angles θ to the plane of electron oscillations, then their frequencies take only a number of values ω', depending on the type of line, atom and field ΔB. As a result, each line of the spectrum is split into a number of close ones with different polarizations, which is the reason for the Zeeman effect [10]. According to Ritz, this explains the normal and anomalous Zeeman effect, where the maximum value is $\Delta\omega = e\Delta B/M$, contrary to Lorentz's theory ($\Delta\omega = e\Delta B/2M$).

The magnetic model also explains the structure of the periodic table, presenting the skeleton of an atom in the form of a bipyramid, the edges of which are formed by magnetic axes [9]. Such a skeleton in the form of a hollow polyhedron is formed during the growth of an electron-positron lattice in the electric and magnetic fields of the nucleus, by analogy with the formation of snowflakes [11], fullerenes, proteins and protein shells of viruses. Electrons fill the core with flat square layers of growing area and capacity $2n2$. This explains why the number of elements in periods No. 1–7 (Fig. 2) are double squares: $2 \cdot 12$, $2 \cdot 22$, $2 \cdot 22$, $2 \cdot 32$, $2 \cdot 32$, $2 \cdot 42$, $2 \cdot 42$. Each layer corresponds to a period. After filling the layer, the next one begins to fill, corresponding to the next period. This explains the properties of inert gases, lanthanides and actinides, for which the quantum model of the atom does not explain atypical valencies [9].

The magnetic model naturally explains the photoelectric effect. The magnetic axes create a barrel-shaped structure of the field B (Fig. 1): it is perpendicular to the median plane of the atomic core and is equal to $B = \mu_0\mu/\pi r_0 r^2$. The Lorentz force $F = eVB = e2\nu\mu_0\mu/r_0 r = MV^2/r$ (taking into account $V = 2\pi r\nu$) acts on an electron flying in an orbit of radius r. Hence, the electron energy $MV^2/2 = \nu e\mu_0\mu/r_0$, where $e\mu_0\mu/r_0 = h$, i.e. $W = h\nu$. These electrons are emitted from the atom when irradiated with light of frequency ν, which causes resonance buildup, de-orbiting and ejection of an electron from the atom with conservation of energy $W = h\nu$. Explains the model and the Planck radiation spectrum and the Compton effect [9].

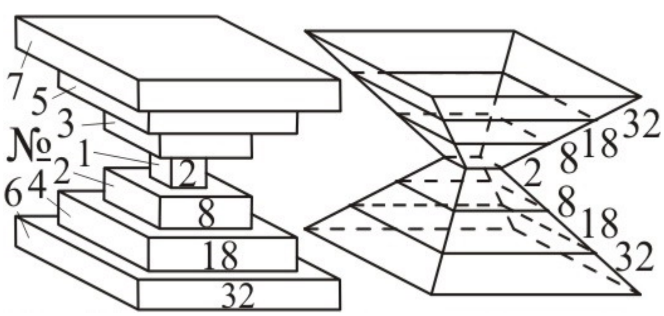

Fig. 2. Scheme of the skeleton, layers of the atom.

The Ritz model classically explains the properties of gases and solids [9], including metals and semiconductors. Thus, the drop in heat capacity upon cooling is explained not by the quantum freezing of the degrees of freedom, but by ordering, an increase in the number of bonds of atoms upon cooling. In a solid, ever larger conglomerates of atoms are formed - rigid molecules, where the atoms vibrate as a whole with an energy of $\sim 3kT$, where k is the Boltzmann constant. With a drop in temperature T, the number N of individual molecules and atoms of the body decreases due to fusion, and the heat capacity $C_V = dU/dT = 3Nk$ decreases. Near absolute zero, one rigid molecule remains, including the entire crystal with an energy of $\sim kT$ and $C_V = k \approx 0$, instead of the usual molar heat capacity $C_V = 3kN_a = 3R$, because $k/R = 1/N_a << 1$. This classically explains the drop in heat capacity to zero. In lead, the atoms are weakly bound, hence its plasticity and $C_V = 3R$ even at T~50 K. But in hard diamond and beryllium $C_V < 3R$ even at T~500 K. And only at T>1000 K their heat capacity $C_V = 3R$, in view of destruction of bonds. Those at T below the Debye temperature Θ_D, there are no deviations from the classical Dulong-Petit law $C_V = 3R$, if we recalculate the heat capacity for a new number of molecules. Classically, Θ_D is the temperature $T_S = W_S/k$, at which the kinetic energy of atoms $\sim kT$ is equal to the energy W_S of their fully saturated bonds. Therefore, $T_S = \Theta_D$ determines the speed of sound, coefficients of elasticity, conductivity, and is large for solids with high W_S (boron, diamond, silicon), but small for lead and alkali metals.

The model also explains the mechanism of generation and amplification of light of a fixed frequency in solid-state lasers and in semiconductor LEDs. For example, if electrons pass through a semiconductor a potential difference U, acquiring energy $W = eU$, then when an atom is captured by a magnetic trap, they begin to rotate in the field B of the core with a fixed frequency $\nu = W/h$, emitting at this frequency (Fig. 1).

Let us note a number of possible applications of the magnetic model in microelectronics. For example, the atoms of a cooled substance, without experiencing collisions and external influences, will be able to keep electrons in the nodes for a long time. This will make it possible to record and store information at the atomic level or to use the atom as a trigger, transferring electrons to specified lattice sites by a *pump*-pulse of a laser. The information is read with a *probe*-pulse with a frequency corresponding to this node. The presence of an electron in a node is detected by the resonant response of the electron. As a working substance for such devices, atoms of transition elements, including atoms of rare-earth elements, with a rich frequency spectrum, i.e. options for placing electrons in the atom. It is no coincidence that elements of transition groups - chromium, erbium, ytterbium, neodymium, etc. are used as active centers in laser technology.

On some types of atoms, where electrons hardly occupy individual sites, but easily leave them (generating forbidden lines), analogs of diodes and transistors can be arranged. Then an atom with a set of nodes will work like a microcircuit, a memory cell. More reliable elements on the electrons of the inner shells, with resonant frequencies in the X-ray region (their frequencies ν are higher, due to the smaller step a), since they are not affected by neighboring atoms and temperature. The ensemble of atoms forms a crystal of record-breaking speed, small size and low power consumption. Switching elements, reading and writing information will be carried out by a laser beam scanning the crystal layer by layer. More convenient is a VUV or X-ray laser that irradiates the nanoscale region and atomic scanning the sample [12]. Because Since X-ray microscopy has reached a resolution of one atom, X-rays are especially convenient for recording and reading information from individual atoms. In a crystal with edges ~1 cm, the number of elements is $\sim 10^{23}$.

The description of such devices is also possible in the language of quantum physics, where energy levels and transitions correspond to the nodes and the emission of electrons in them. And quantum computers are partly analogous to the atomic computers considered. Another application of the magnetic model is the creation of three-dimensional hologram images in the air. To do this, air molecules should be transferred to an excited metastable state by passing air through the irradiated area with UV rays or laser pump pulses, and then irradiating the air at specified points with a probe pulse leading to the emission of the stored energy. Renewal of the air in the display area will allow the formation of dynamic pictures - moving images, volumetric films, for the implementation of 3D television.

The crystalline magnetic model of the atom also explains the properties of the atomic nucleus, presenting it as a quasicrystal of protons and neutrons, which in turn have the form of electron-positron crystals, where e^+ and e^- electrons alternate as Na^+ and Cl^- ions in salt crystals (Fig. 3). In a neutron, the numbers of electrons and positrons are the same, and in a proton there are one more positrons than electrons, hence its positive charge. Then the nuclear forces of adhesion of nucleons, as shown by V. Manturov, of an electrical nature are the forces of attraction of electrons and positrons on the faces [9, 13].

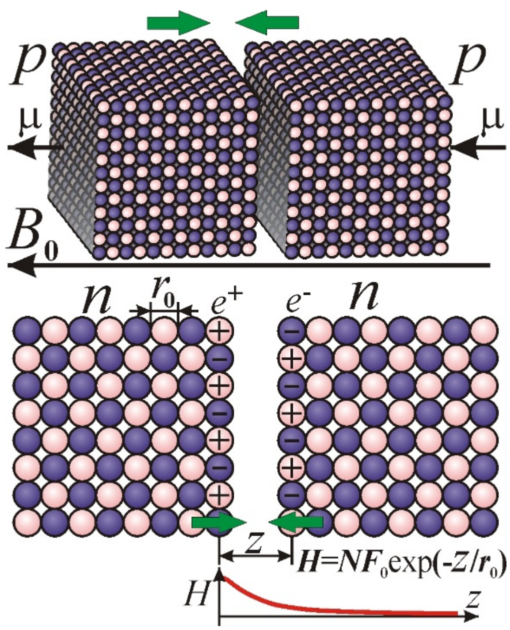

Fig. 3. Synthesis of nuclei in field B and the nature of nuclear forces.

This model of the proton, neutron and other elementary particles explains the values of their masses, sizes, charge, magnetic moment, the mechanism of interactions and decays. So, the nuclear interaction of two protons, which exceeds their Coulomb repulsion, is a direct consequence of their multipole interaction. If two protons *p* in the form of cubic crystals are in contact with their faces, so that positrons will be opposite the electrons and vice versa, their attraction will exceed the Coulomb repulsion of protons (Fig. 3). As calculations show [9], the attractive force *H* decreases exponentially with increasing distance *z* between the faces: $H \approx F_0 N\exp(-z/r_0)$, where F_0 is the elementary force of attraction of an electron to a positron at a distance of the order of r_0, and *N* is the number of particles forming each face (for nucleons $N \sim 100$). That is, the nuclear force *H* is 100 times more intense than the Coulomb interaction, and rapidly decreases with distance, in agreement with experience. The same attractive force *H* will arise between two neutrons *n*, and between a proton *p* and a neutron *n*, which have similar masses, sizes and shapes.

So, the crystal model of nucleons explains all the properties of nuclear forces: their equality in bonds of the *p-p, n-n, n-p* type; high intensity; short-range character and fast decay with distance (due to multipole interaction), saturation (faces of neighboring nucleons interact). The model leads to the value of the radius of action of nuclear forces $\sim r_0$ (the classical radius of the electron), which quantum physics does not explain. The strength of bonds like *p-p*, *n-n* is slightly higher than *n-p* (pairing energy, which increases the stability of even-even nuclei), because for protons and neutrons from a small difference in the size of the faces, the number of bonds *N* and the force *H* are maximal at the contact of particles of the same type, due to the equality of the faces.

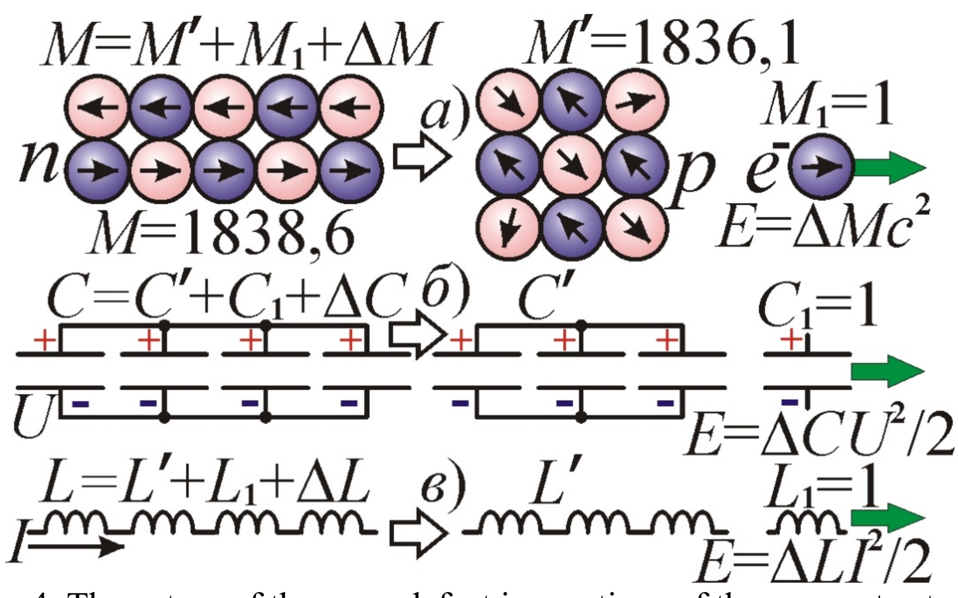

Fig. 4. The nature of the mass defect in reactions of the $n \rightarrow p + e$ type.

Since the step r_0 of the electron-positron lattice is 10^5 times less than the step a of the atomic core, the nuclear vibration frequencies ν are 10^8–10^{10} times higher than the frequencies of the optical atomic spectra, that is, they lie in the gamma range, in agreement with experiment. Placing electrons or protons at the nodes of an electron-positron "crystal" opens up another way of recording and processing information - not at the atomic, but at the nuclear level. Information is written in the form of coordinates of electrons or protons in the nucleus. Because, since binding energies in nuclei are much higher than in atoms, it is not necessary to cool the substance to temperatures close to absolute zero to store information. Thus, it is possible to build supercapacity storage media and nuclear computers that operate at room temperature.

The electrical nature of nuclear forces explains the energy of nuclear reactions and the mass defect found in them. As shown by Ritz [9], relying on Lorentz's ideas, the interaction of charges during their acceleration leads to the appearance of an uncompensated electromagnetic force, ie. to the appearance of an additional inert mass. The repulsive interaction of charges creates a positive inert mass, and the attractive one creates a negative one. Then the addition or separation of particles and charges associated with them changes the mass of particles, nuclei, not only by the amount of the attached or separated part, but also by the amount of electromagnetic mass ΔM associated with their interaction. This mass defect ΔM is proportional to the energy released or absorbed in the reaction $\Delta W = \Delta Mc^2$ - a ratio obtained in the 19th century by J.J. Thomson even within the framework of classical physics. So in electrostatics the energy $W = CU^2/2$ and the total capacitance C is made up of the self-energies and capacities of the capacitors and from the small mutual energies and capacities ΔC, from the interaction of the capacitor plates (Fig. 4). Removing a capacitor of unit capacity reduces the total energy and capacity of the circuit by more than one. This released interaction energy $\Delta W = \Delta CU^2/2$ is proportional to the "disappeared" parasitic capacitance ΔC.

The same is true for a circuit with inductances L. It is not for nothing that the inertial role of the capacitance C and inductance L in the circuits is compared with the role of the mass M of the load on the spring. Likewise, when an electron is separated from a neutron, it, having become a proton, changes the shape and interaction energy ΔW of the electrons and positrons that form it and the associated electromagnetic addition of mass $\Delta M = \Delta W/c^2$. The change in the structure of a proton formed from a neutron follows from the difference in their magnetic moments by 1.5 times. That is, the distributions of the moments of electrons and positrons differ, which together give the magnetic moment of the nucleon.

Nucleons in the nucleus, like electrons in the magnetic model of the atom, are stacked in the form of a double pyramid, where neutron layers alternate with proton layers (Fig. 5). This explains the magic numbers of nucleons that form especially stable combinations: 2, 8, 14, 20, 28, 50, 82, 126 [14]. The values 2, 8, 20 are double pyramidal numbers of the form $n\,(n + 1)\,(n + 2) / 3$. Other numbers are found as the doubled sum of the n-th triangular number and the $(n - 2)$ -th pyramidal number: $n\,(n + 1) + n\,(n - 1)\,(n - 2) / 3 = (n^3 + 5n) / 3$. Indeed, the nuclei exhibit properties that indicate the crystal structure and pyramidal shape of the nucleus [15, 16]. The pyramid can have a square base in the case of cubic nucleons [9], or triangular, if the paired nucleons have the form of rhombic dodecahedrons, joining in a kind of honeycomb [11].

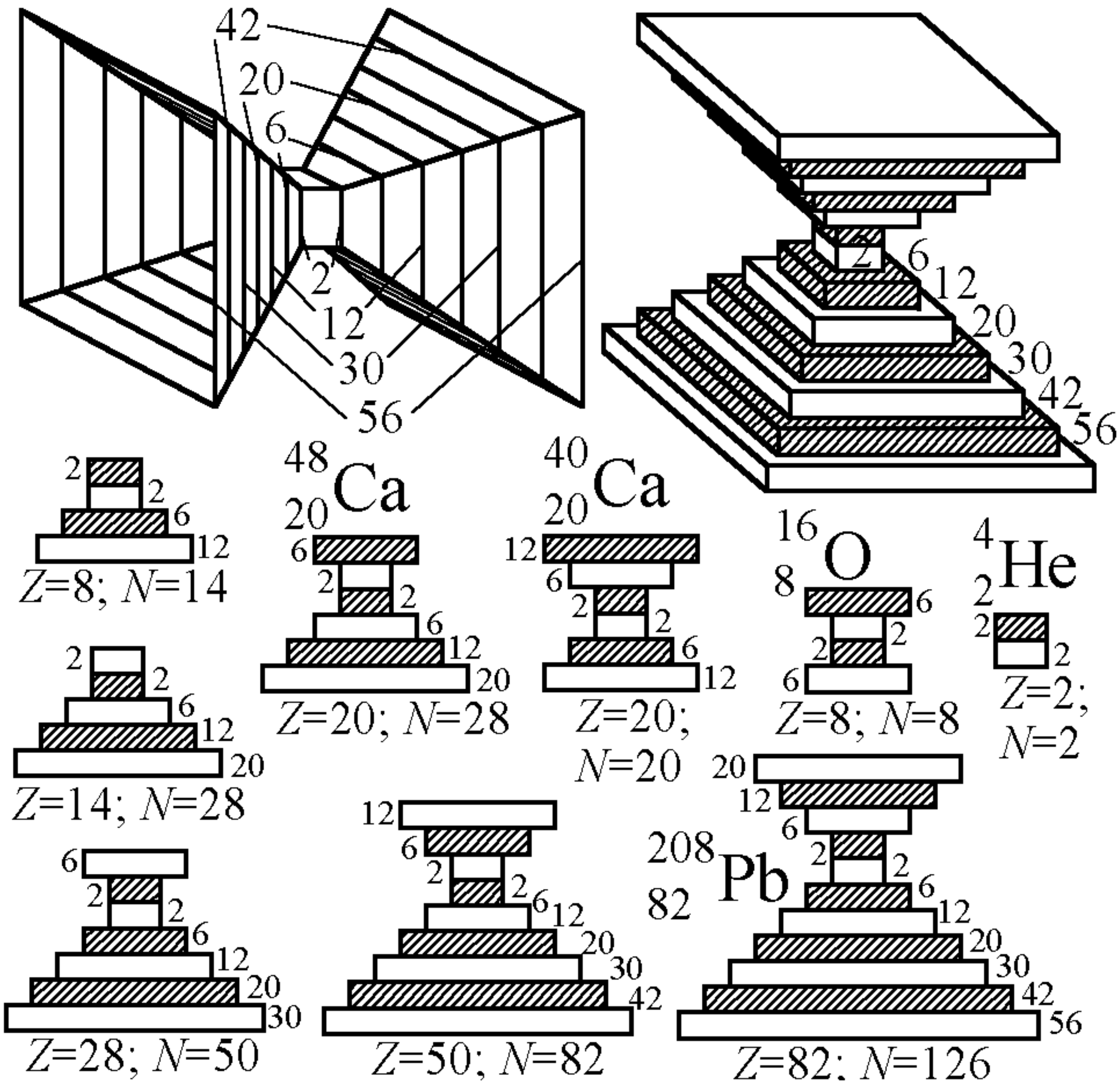

Fig. 5. Schemes and capacities of nucleon layers in nuclei: p - dark, n - white.

The hypothesis can be easily verified by the Laue method: by irradiating atoms with gamma rays with a wavelength $\lambda<10^{-15}$ m, the step and type of the crystal lattice can be determined from the diffraction pattern. A powerful electric field and laser radiation can lead to the decay of such nuclei, upon reaching the threshold $E \sim e/4\pi\varepsilon_0 r_0^2 \sim 10^{19}$ V / cm, at which the field E separates electrons and positrons, leading to disintegration of particles, decay of nuclei, upsetting the balance of forces of attraction and repulsion (fig. 6). For unstable nuclei, laser irradiation and strong fields E will change the decay rate. Such effects, confirming the electrical nature of nuclear forces, were discovered in experiments [17, 18]. The efficiency of such processes can be increased by orienting the nuclei with an electric or magnetic field and acting with the laser field in the direction of the lowest intensity of the binding forces between the nuclear charges [19]. You can also dissect a nuclear “crystal” along the “cleavage planes” with a “laser scalpel”, sequentially breaking bonds, creating dislocations and other defects, as in real crystals, facilitating deformation and rupture.

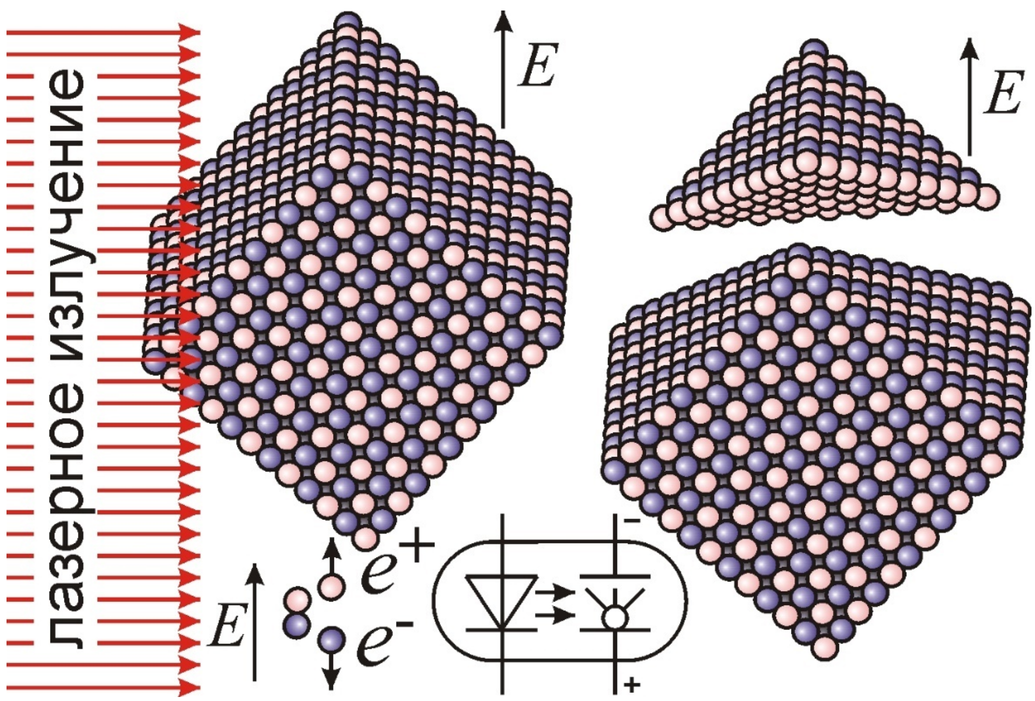

Fig. 6. Separation of particles by a laser field and a reactoptron.

The model makes it possible to carry out nuclear fusion reactions, if nuclei are connected, orienting them to maximize nuclear forces and smoothly bringing them together with ponderomotive forces in a laser field. The use of semiconductor lasers and KLM-laser microchips for these purposes will make it possible to realize compact and almost inexhaustible sources of energy (reactoptrons, Fig. 6), built into microcircuits, for their autonomous power supply. In such a source, enhancing the α- or β-decay [18], so that the α-particles or electrons emitted by one electrode are deposited on the other, it is possible to create an electromotive force controlled by the light intensity. The microprocessor does not require enhanced radiation shielding because the penetrating ability of α- and β-rays is low.

So, like atomic vortices and gears in Maxwell's theory, which reminded contemporaries of machine tools and factories, in the magnetic model the atom and atomic nucleus resemble electronic devices (cyclotron, gyrotron, horn antenna, etc.), semiconductor crystals, where charges move along the lattice nodes ... The magnetic model of the atom not only explains the properties of atoms and nuclei, but also opens the way for creating promising electronic devices and power sources for microelectronics.

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