

ON WAVE NATURE OF MATTER

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Abstract

The article proves the alternative concept of the wave structure of matter. It shows the existence in a non-baryonic (dark) matter of the Universe of standing density waves with dipole properties. When condensation of a non-baryonic substance, these waves transform it into a baryonic (light) substance by forming in it various closed wave structures with particle-like properties. The mathematical description of processes of structuring of non-baryonic matter proposed in the article explains the appearance of new properties (degrees of freedom) in baryonic matter by its polarization. Wave processes in baryonic matter excite running waves in non-baryonic matter, which gives it the properties of a luminiferous medium and makes the baryonic matter visible. The article shows that such a concept allows us to take a fresh look at a number of phenomena that are difficult to explain from the standpoint of corpuscular theories, and finds all the new experimental confirmations.

Keywords: alternative to atomism, waves of dark matter, particle-like wave, closed waves, formation and structuring processes, non-baryonic and baryonic matter transformation, wave structures, strong gravity, unity of interactions; experimental confirmation.

“What we currently consider as particles are actually waves”

E. Schrödinger [1]

Preface

The idea that everything is "waves, and only waves" [1], began to take possession of the minds of researchers as they penetrated into the structure of atoms and discovered subatomic particles, the number of which had already reached several hundred. However, the concept of atomism, based on the concept of indivisible and uncreatable "building blocks of the universe," has not been abandoned until now, despite the experimentally proven absence of indivisible particles. It only transformed into the idea of dualism "wave-particle", put forward as a compromise by de Broglie (1923). To reconcile quantum and wave representations, he suggested the existence of a "fictitious wave" (the de Broglie wave), whose frequency is consistent with the internal oscillatory process in the particle itself. However, despite the discovery in 1927 of electron diffraction by de Broglie until the end of his life, he remained unsatisfied with this hypothesis, instinctively feeling that "the waves described by quantum mechanics are the system itself" [2].

Indeed, the idea of dualism ignores the fundamental difference of waves from particles: the wave has a certain extent in space and a characteristic structure - the presence of nodes and antinodes, along with a periodic deviation of the oscillating magnitude in both directions from the mean value. The result of their action is also qualitatively different: waves cause resonant vibrations of the object of their action without changing its density, while the emission or absorbed particles occurs in the absence of oscillations ("jump") and is accompanied by a change in the mass of the bodies.

Much further de Broglie went to the famous physicist and astronomer Jeans who argued that "in nature there are waves and only waves: closed waves, which we call matter, and non-

closed waves, which we call radiation or light" [3]. The description of such de Broglie "waves of matter" was attempted by E. Schrodinger, who considered the wave equations "more suitable for describing the microworld" [4].

We will not discuss here numerous experiments, most of which can be interpreted both in favor of the corpuscular and wave concept of the structure of matter. We only note that the positions of the latter have become noticeably stronger after the discovery of the existence of solitons-solitary structurally stable and particle-like waves of elevation, which behave like billiard balls in a "collision" [5]. Their study showed that "particle-like" properties are inherent in other classes of waves. At present, on the basis of known experiments on the annihilation of electron-positron pairs and the conversion of radiation into them, a whole direction of annihilation spectroscopy has arisen, which for practical purposes uses data on the transformation of radiation into other structural elements of matter [6].

In this regard, great importance is the discovery of wave processes not only in micro, but also in megaworld. So, with the development of observational astronomy, it was discovered that quite real waves of matter density exist also in the so-called "cosmic vacuum" (a space with a density of the order of 10^{-27} g/cm³). They manifest themselves both in the form of "shock waves" (such as the "Zeta Ophiuchi" star, which moves with a speed of 24 km/s [7]) detected by the "WISE" telescope, and in the phenomenon of "long delayed echoes" - a sporadic occurrence in the space environment Geocentrically oriented surfaces ("radiomirrors") that cause the reflection of a radio signal [8].

However, the most convincing evidence of the wave structure of the universe was the discovery in it of spherical clusters of galaxies acquiring in the section (at a fixed distance from the observer) the form of the ring structures shown in Fig. 1. This result was obtained recently in the laboratory of Lawrence Berkeley (USA) in the framework of the Digital Sky Survey (SDSS)

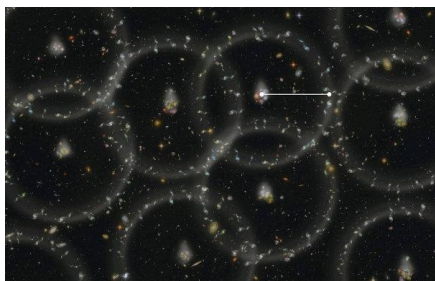


Рис.1. Map of the Universe with the image of ring structures.
(Source: Berkeley National Laboratory)

project, the main purpose of which was to compile a three-dimensional map of the sky with the calculation (up to 1%) of s of 1.5 million star coordinate [9]. Analyzing available data on the distribution of 1.2 million celestial bodies at a fixed distance from the observer, scientists have discovered that galaxies are concentrated mainly either in its center or on the surface of spheres with a diameter of about half a billion light years. In a section such clusters of galaxies look like ring structures resembling running waves in standing water when large drops of rain fall in them. The approximate equality of the diameters of these clusters in

different regions of the universe and their similarity gave grounds for interpreting them as baryonic acoustic oscillations of its matter [10]. Thus, at present, the wave concept of the structure of matter receives all the rights to exist.

The proposed article attempts to substantiate this concept from the standpoint of "energy dynamics" as a theory that realized the synthesis of mechanics, thermodynamics, hydrodynamics and electrodynamics, and gives a unified mathematical description of discrete and continuous media with any finite number of degrees of freedom of one or another nature [11].

1. The process of wave formation in non-baryonic matter

Energodynamics, like thermodynamics, has a phenomenological character, i.e. relies on a preliminary experimental study of the object, rather than on hypotheses and postulates. It is also alien to attract model representations about the structure of matter and the "mechanism" of processes to justify any of its provisions. Therefore, its consequences acquire a high degree of reliability. However, unlike classical and non-equilibrium thermodynamics, energodynamics studies heterogeneous systems not on the basis of hypotheses about global or local equilibrium [12], but by introducing specific parameters of spatial heterogeneity, not "hidden" but strictly grounded and having a clear physical meaning.

Consider from these positions the processes of formation of the "bright" (visible, baryonic) matter in the universe, supposing the predominance of "dark" (invisible, non-baryonic) matter in it to be a firmly established fact [13, 14]. Let us first show that the processes occurring in systems with an inhomogeneous density lead to opposite changes in the state in different parts of it. In order to prove this, it is sufficient to select in a research object the volume V of a subsystem with volumes V' and V'' , within which the density $\rho(\mathbf{r}, t) = d\Theta/dV$ of any extensive parameter of the system Θ (mass M , charge Q , number of moles k -th substances N_k , impuls \mathbf{P} , its moment \mathbf{L} , etc.) is greater or less than their average value $\bar{\rho} = V^{-1} \int \rho dV = \Theta/V$. Then, by the obvious equality $\int \rho dV = \int \bar{\rho} dV = \Theta$, we have:

$$\int (\rho' - \bar{\rho}) dV' + \int (\rho'' - \bar{\rho}) dV'' = 0. \quad (1)$$

In non-homogeneous systems (where $\rho' - \bar{\rho} \neq 0$ and $\rho'' - \bar{\rho} \neq 0$), equality (1) is clearly observed in the only case when these deviations in the different regions, phases and components of the system have the opposite sign and are mutually compensated. In [10] "the principle of the opposite direction of processes," reflects the main difference between energy dynamics and the thermodynamics of non-equilibrium systems [13]. It predetermines the inevitability of the formation of wave formation in non-baryonic matter. To see this, we first consider the case of a "homogeneous inhomogeneity" when the density $\rho_i(\mathbf{r}, t)$ of a parameter as a function of spatial coordinates (radius-vector \mathbf{r}) and time t) monotonically changes in any direction, together with the averaged value of the its potential Ψ_i (temperature, pressure, velocity, chemical, electrical, gravitational, etc. potentials), as shown in Fig.2.

As follows from the figure, if the distribution of Θ_i deviates from the uniform distribution

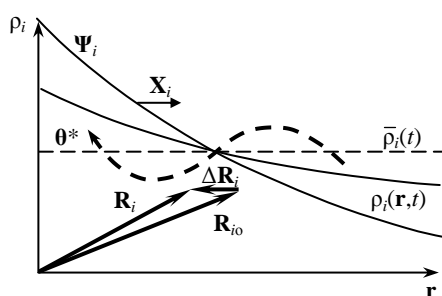


Fig. 2. Moment of Distribution
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with density $\bar{\rho}_i(t)$, some amount of this quantity Θ_i^* is transferred from one part of the system to another in the direction indicated by the arrow. This "redistribution" of the extensive value of Θ_i causes the center to shift from the initial position of \mathbf{R}_{i0} to the current \mathbf{R}_i . This leads to the formation of the "moment of distribution" \mathbf{Z}_i of energy carriers Θ_i with the arm $\Delta \mathbf{R}_i = \mathbf{R}_i - \mathbf{R}_{i0}$ [10]:

$$\mathbf{Z}_i = \Theta_i \Delta \mathbf{R}_i = \int_V [\rho_i(\mathbf{r}, t) - \bar{\rho}_i(t)] \mathbf{r} dV. \quad (2)$$

Derivatives with respect to time t from the vectors \mathbf{Z}_i have the meaning of the generalized momentum of the energy carrier Θ_i and are called in the thermodynamics of irreversible processes [13] and energy dynamics [10] fluxes:

$$\mathbf{J}_i = d\mathbf{Z}_i/dt = \Theta_i \mathbf{v}_i, \quad (3)$$

where $\mathbf{v}_i = d\mathbf{R}_i/dt$ is the rate of transfer (redistribution) of the quantity Θ_i within the system.

The elementary change in the $d\mathbf{Z}_i$ of the moment \mathbf{Z}_i can be caused by three reasons: a change in the value of Θ_i with a constant shoulder $\Delta\mathbf{R}_i$, a change in the arm length $\Delta\mathbf{r}_i = \Delta\mathbf{R}_i/\mathbf{e}_i$ without changing its direction given by the unit orthom \mathbf{e}_i , and changing the spatial angle φ_i of the vector $\Delta\mathbf{R}_i$ orientation in space with unchanged $\Delta\mathbf{r}_i$ due to reorientation of the system. In the general case, such changes in the state are inherent in all forms of energy, the quantitative measure of the material carriers of which (briefly: energy carriers) is the parameters Θ_i . They are also typical for the substance of the universe: the mass M_g of celestial bodies changes in the processes of accretion of matter, the arm $\Delta\mathbf{r}_g$ of the moment of mass distribution \mathbf{Z}_g due to the flow of matter from one star to another in close binary star systems, and the angle φ_g due to the reorientation of the vector $\Delta\mathbf{R}_g$ upon rotation of galaxies.

From a mathematical point of view, this means that the energy \mathcal{E} of an inhomogeneous system with an arbitrary number of i -forms of energy \mathcal{E}_i has the form $\mathcal{E} = \mathcal{E}(\Theta_i, \Delta\mathbf{r}_i, \varphi_i)$, as its state function, so that its total differential can be written in the form of the identity [11]:

$$d\mathcal{E} \equiv \sum_i \psi_i d\Theta_i - \sum_i \mathbf{F}_i \cdot d\mathbf{r}_i - \sum_i \mathbf{M}_i \cdot d\varphi_i, \quad (4)$$

where $\psi_i \equiv (\partial\mathcal{E}/\partial\Theta_i)$ is the averaged value of the generalized potential of the inhomogeneous system (absolute temperature T and pressure p , electric φ , chemical μ_k of the k^{th} substance potential, translational and rotational velocity of its motion \mathbf{v}_k and $\boldsymbol{\omega}_k$ etc.); $\mathbf{F}_i \equiv -(\partial\mathcal{E}/\partial\mathbf{r}_i)$ – forces in their traditional (Newtonian) understanding; $\mathbf{M}_i \equiv -(\partial\mathcal{E}/\partial\varphi_i)$ are the torques of these forces; $i = 1, 2, \dots, n$ is the number of forms of energy that the system has.

According to (4), any forces \mathbf{F}_i , like their specific value $\mathbf{X}_i = \mathbf{F}_i/\Theta_i = -\Theta_i(\partial\mathcal{E}/\partial\mathbf{Z}_i)$, are generated by the spatial inhomogeneity of the system and represent the gradients of the corresponding energy form, taken with the opposite sign. The direction of these is shown in Fig.2 by an arrow. This is also true for gravitational forces due to the inhomogeneous distribution of matter in the universe. These forces, like their fields, would be more correct to be called not mass gravitational, since they are not only gravitational forces, but also repulsion, i.e. Bipolar, and their material carrier (briefly: energy carrier) is any substance. Their value is determined by the gradient of the gravitational potential $\psi_g = (\partial\mathcal{E}/\partial M_g)$, which, by virtue of the principle of equivalence of mass and energy, is equal to the square of the speed of light c^2 (J/kg). Its magnitude exceeds the gravitational potential by many orders of magnitude, which follows from the law of gravitation of Newton, which takes into account only the pair interactions of gravitating bodies [15]. This circumstance confirms the existence of "strong gravity" [16], bringing us closer to the understanding that all forces acting in ordinary matter have, in the final analysis, a unified nature and become clearly discernable only after the appearance of new degrees of freedom.

In homogeneous systems (where $d\mathbf{r}_i$ и $d\phi_i = 0$), the terms of the second and third sum of identity (3) vanish, and it goes over into the basic equation of the nonequilibrium thermodynamics of polyvariant systems based on the local equilibrium hypothesis [12]. Thus, in energy dynamics, inhomogeneous systems are generally characterized by tripling the number of independent state parameters. Another difference is that, taking into account the processes of redistribution and reorientation described by the second and third sums of identity (3), energy dynamics acquires the ability to investigate internal processes in isolated systems (where $d\mathcal{E} = 0$), including the processes of circulation matter in the universe.

In this case, it can be shown that the process of transforming non-baryonic matter into a baryonic matter, bypassing the process of wave formation, is impossible. To this end, we use the condition of isolation of the system. The absence of an external force acting on it means that the resultant of the internal forces \mathbf{F}^i in it also vanishes. we express this force in terms of its specific value \mathbf{f}^i by the integral:

$$\mathbf{F}^i = \int \mathbf{f}^i dM = 0. \quad (5)$$

Hence it follows that when any processes occur in the system, the internal forces \mathbf{f}^i can arise or disappear only by the pairs $\mathbf{f}^i > 0$ and $\mathbf{f}^i < 0$. These forces act on different elements of the mass dM and, therefore, do not compensate each other. In other words, Newton's third law is also observed for internal forces. It is quite obvious that the appearance of a pair of oppositely directed forces is connected with the deviation of the local density $\rho_i(\mathbf{r}, t)$ of the parameter Θ_i in both directions from the mean value, as shown in Fig.3. This process of wave formation is

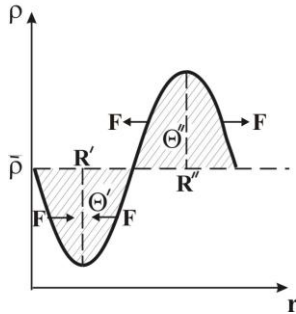


Fig.3. Wave as Dipole

accompanied by the transfer of some part $\Theta_i' = \int (\rho_i - \bar{\rho}_i) dV'$ of the quantity Θ_i from the point \mathbf{R}' to the point \mathbf{R}'' , which leads to the formation of a dipole with the polarization moment

$$\mathbf{Z}_i = \Theta_i \mathbf{R}' + \Theta_i'' \mathbf{R}'' = \Theta_i' \Delta \mathbf{R}_i \quad (6)$$

and the arm $\Delta \mathbf{R}_i = \mathbf{R}'' - \mathbf{R}'$. An example of a moment of this kind is the electric displacement vector \mathbf{D} in a dielectric of unit volume for which Θ' and Θ'' are the associated (polarized) positive and negative charges, and $\Delta \mathbf{R}_i = \mathbf{R}'' - \mathbf{R}'$ – shoulder of the dipole moment \mathbf{D} . Such a process also takes place in non-baryonic matter, leading to the appearance in it of the moment of distribution of its mass M_B : $\mathbf{Z}_g = \Theta_g' \Delta \mathbf{R}_g$, where $\int \rho_g dV = \Theta_g' = \frac{1}{2} M_B$. The longitudinal density waves arising in this case are acoustic in nature. Looking ahead, we note that such waves do not transfer energy through their nodes, which leaves the non-baryonic substance of the universe invisible (dark).

As follows from Fig. 3, any wave is a dipole with a pair of oppositely directed forces, which in a region with excessive density "repel" neighboring wave whirls (generating the desire of the gravitational wave to occupy all the volume provided to it), and in an area of insufficient density Both sides of the wave "pull together", trying to reduce this area. In other words, any pair of forces arising in an inhomogeneous system is aimed at establishing equilibrium in the system (its relaxation). Such a pair of forces, referred to a system of unit volume is usually called tension. These parameters differ from forces in that they are intensive quantities. We shall denote

them by the symbol \mathbf{H}_i , determining, in contrast to the forces \mathbf{F}_i , the partial derivatives of the unit volume of the system \mathcal{E}_v from the moment of the distribution \mathbf{Z}_{iv} :

$$\mathbf{H}_i = -(\partial\mathcal{E}_v/\partial\mathbf{Z}_{iv}). \quad (7)$$

These are, in particular, the electric and magnetic field strengths \mathbf{E} , \mathbf{H}_m .

An analogous concept can also be introduced for an acoustic field as a function of the density distribution ρ in a wave. Since the displacement of the mass M_B in the wave by a distance $\Delta\mathbf{r}_B$ is carried out during the oscillation period τ , inverse to its frequency ν , then its average velocity in this process is $\bar{\mathbf{v}}_B = \nu\Delta\mathbf{r}_B$. This corresponds to the average energy density in the wave $\mathcal{E}_v = \rho\bar{v}_B^2/2$. If we now take the displacement $\Delta\mathbf{r}_B$ as the amplitude of the longitudinal wave A , we arrive at the well-known expression for the energy density of the acoustic wave \mathcal{E}_B [15]:

$$\mathcal{E}_B = \rho A^2 \nu^2 / 2, \quad (\text{Дж/М}^3), \quad (8)$$

However, as the local velocity of the center of mass displacement $\mathbf{v}_B = d\mathbf{r}_B/dt$ increases from the node to its wave antinodes, the kinetic energy is distributed \mathcal{E}_B wavelength also uneven. This makes the acoustic field intensity $\mathbf{H}_B = -(\partial\mathcal{E}_v/\partial\mathbf{Z}_{Bv})$ in a wave different from zero. The meaning of this quantity is easy to establish, taking into account that $d\mathcal{E}_v = \rho v dv$ and $d\mathbf{Z}_{iv} = \rho d\mathbf{r}_B$. Therefore, $\mathbf{H}_B = -(\partial\mathcal{E}_v/\partial\mathbf{Z}_{Bv}) = \nu\nabla v$, i.e. Has the sense of acceleration $\mathbf{a} = \nu\nabla v$. In the same way, we can introduce the concept of the intensity of the gravitational field $\mathbf{H}_g = -(\partial\mathcal{E}_v/\partial\mathbf{Z}_{gv})$, which will have the meaning of the acceleration of gravity \mathbf{g} .

The unity of the forms of representation of various kinds of work of polarization allows us to write down the identity (3) for a system of unit volume in the form

$$d\mathcal{E}_v \equiv \sum_i \psi_i d\rho_i - \sum_i \mathbf{H}_i \cdot d\mathbf{Z}_{iv} - \sum_i \mathbf{M}_{iv} \cdot d\boldsymbol{\phi}_i, \quad (9)$$

in which the terms of the second sum characterize the elementary work of polarization of baryonic matter $dW_v = \sum_i \mathbf{H}_i \cdot d\mathbf{Z}_{iv}$.

From (9) it follows that a system which in the equilibrium state possessed only the gravitational form of the energy \mathcal{E}_g , with the appearance of oscillations in it acquires new forms of energy \mathcal{E}_i , and, first of all, kinetic energy with density \mathcal{E}_B . This makes the non-baryonic substance capable of doing work, since this concept in mechanics is inextricably linked with the displacement $\Delta\mathbf{r}_i$ of the object of applying the force \mathbf{F}_i .

Thus, the process of wave formation is the first and necessary step in the transformation of non-baryonic matter into baryon matter. In this case, in accordance with the conservation law, the energy \mathcal{E} of the system remains unchanged with the acquisition of its additional degrees of freedom of it and equal to the rest energy of the system \mathcal{E}_0 in its initial (unperturbed) state $\sum_i \mathcal{E}_i = \mathcal{E}_0$, and is not added to it, as is customary in quantum mechanics. It seems therefore expedient to consider these processes in more detail.

2. The processes of transformation of non-baryonic matter into baryon matter

As we have shown above, the process of wave formation in non-baryonic matter has a dynamic (power) character and leads to the appearance of dipole properties in any single wave. However, the maximum density of non-baryonic matter in a wave according to Fig. 3 can not exceed twice its average density $\bar{\rho}$. Therefore, for the formation of a baryonic substance, a preliminary achievement of a certain local density ρ is required by a non-baryonic substance. This process is carried out in non-equilibrium processes of its "condensation" in some, and "rarefaction" in other areas of the universe. This process is often called "condensation", since it is accompanied by a condensation of the starting material. However, one condensation is clearly not enough here. To convert non-baryonic (unstructured) matter into baryonic (structured) matter, it is necessary to perform in it the internal work of "polarization" in the most general sense of this term, i.e. to create spatial heterogeneity in the distribution of any of its properties. Such work is performed by a pair of oppositely directed forces that arose in the process of wave formation in non-baryonic matter. The work of polarization removes the system from the state of internal equilibrium (i.e, it is performed "against equilibrium" in it) and is expressed, in particular, in the acceleration of the chaotic relative motion of its microscopic parts (heating of the system), in the volume and shear deformation of the object, in the excitation of the relative translational and rotational motion of its components, in its electric and magnetic polarization, dissociation and ionization, in the initiation of photochemical and photonuclear reactions in it, etc. Such processes lead to the formation of certain structures in the system.

The greatest interest in this regard is represented by processes in which not only the deviation of a property in both directions from its average level occurs, but new properties of an opposite nature that have not been observed before. This is, in particular, the process of polarization of dielectrics. It consists in the appearance and spatial separation of so-called "connected" charges, the physical essence of which, like free charges, is still unclear. It is known only that these charges have different signs, i.e. generate either repulsive forces (such charges are called of the same name), or attraction (they are called unlike). Before the establishment of the existence of analogous properties for any other forces arising in the wave (including gravitational forces, which change sign depending on the direction in which the center of mass shifts towards a larger or smaller density [15]), the electric forces were considered to be forces of some special (non-gravitational and non-acoustic) nature, and their carriers were named after the mineral, the first to discover this property. However, it now becomes clear that the nature of all forces is one, and only the ways of isolating baryonic matter from the action of these forces and the degree of their weakening with distance are determined. If, by tradition, the spatial separation of bound charges described by the moment of their distribution in a system of unit volume $\mathbf{Z}_{ev}(\mathbf{r},t)$, is traditionally called electric polarization, then it becomes obvious that this moment has the same meaning as the vector of electric induction (electric displacement) \mathbf{D} . In this case, the derivative $d\mathbf{Z}_{ev}/dt$ determines the density $\mathbf{j}_e = d\mathbf{D}/dt$ so-called "cohesive flow", which is traditionally represented by the number of imaginary lines of force permeating the unit cross-section of the electrical circuit [12]. In the general case, the total time derivative of the moment of the distribution $\mathbf{Z}_{iv}(\mathbf{r},t)$ has the form:

$$d\mathbf{Z}_{iv}/dt = (\mathbf{v}_i \cdot \nabla) \mathbf{Z}_{iv} + (\partial \mathbf{Z}_{iv} / \partial t)_{\mathbf{r}}. \quad (10)$$

Here $(\mathbf{v}_i \cdot \nabla) \mathbf{Z}_{iv} = \rho_i \mathbf{v}_i$ is the so-called convective component of the rate of change of the moment \mathbf{Z}_{iv} , due to the transfer of Θ_i with the local velocity \mathbf{v}_i ; $(\partial \mathbf{Z}_{iv} / \partial t)_r$ is its local component due to the oscillations of \mathbf{Z}_{iv} at the point with the radius vector \mathbf{r} . In electrodynamics, this component corresponds to the density of the conduction current, $\mathbf{i}_e = (\mathbf{v}_e \cdot \nabla) \mathbf{D} = \rho_e \mathbf{v}_e$, due to the transfer of a free charge of density $\rho_e = \text{div } \mathbf{D}$ with a local velocity \mathbf{v}_e , and the local component of the total current $(\partial \mathbf{D} / \partial t)$, called Maxwell's "bias current".

If, by analogy with the expressions $\mathbf{D} = \epsilon \mathbf{E}$ and $\mathbf{B} = \mu \mathbf{H}$ known from electrodynamics, we associate the moments of the distribution \mathbf{Z}_{iv} with the \mathbf{H}_i intensities by the linear dependence $\mathbf{Z}_{iv} = \epsilon \mathbf{H}_i$, where ϵ is a certain proportionality coefficient analogous in the sense of the electric ϵ and magnetic μ permeability of the substance, then the expression (10) can be given the form of the equation of the wave of tension \mathbf{H}_i :

$$\partial \mathbf{H}_i / \partial t + \mathbf{v}_i \cdot \partial \mathbf{H}_i / \partial \mathbf{r} = d \mathbf{H}_i / dt. \quad (11)$$

This equation belongs to the class of the so-called kinematic equations of a wave with attenuation $d \mathbf{H}_i / dt$, which differ from the second-order dynamic equations in that they describe a wave propagating in one direction (from a source) with a velocity v [15].

All of the above applies to the magnetization process, whose essence from the viewpoint of energy dynamics is the spatial separation of the direction of rotation of molecular currents [11]. This leads to the appearance of the moment of distribution of the momentum of the rotational motion \mathbf{Z}_{pv} , which is equivalent to the concept of the magnetic induction vector \mathbf{B} . Such an approach does not require the search for "magnetic monopoles" as analogues of free electric charge and reveals the meaning of the vector magnetic potential \mathbf{A} as the angular velocity of the rotational motion of the charge.

Similarly, energodynamics describes other processes of polarization, the essence of which lies in the spatial separation of the system into components, ions, nucleons, etc. The same thing happens essentially in the process of excitation in the system of chaotic (thermal) form of motion, which is characterized by the opposite direction of the impulses of individual "particles" in the chaotic motion (for a non-zero module called us instead of entropy "thermoimpulse" [11].

The presence of additional degrees of freedom in baryonic matter makes it capable of modulating in the surrounding non-baryonic medium traveling acoustic waves of density with wave characteristics inherent in the structural elements of baryonic matter. This follows directly from expression (10), which is the so-called "kinematic" wave equation of the inhomogeneity parameter \mathbf{Z}_{iv} . Such a wave equation differs from the so-called "dynamic" wave equation of the second order only in that it describes a wave propagating in one direction. Continuous radiation of such waves makes non-baryonic matter a luminiferous medium similar to ether. These traveling waves make the baryonic substance visible ("light").

3. Formation of closed waves as a process of structuring baryonic matter

Waves arising in an inhomogeneous medium inevitably experience a partial reflection on these inhomogeneities. This leads to the imposition of a forward and backward wave and the appearance of a stack of standing waves with lengths that are multiples of an integer number of waves. The length of the first wave (the first harmonic) corresponds to the distance between the inhomogeneities; The 2nd, 3rd, 3rd, etc. harmonics correspond to 2, 3, etc. wave. However, when the reflection coefficient is less than unity, some of the direct density waves penetrate

through these obstacles and cause the packet to "flatten out" under the action of "repulsion" forces between the antinodes shown in Fig.3. If the trajectory of such a wave turns out to be a curved attraction of massive objects or the influence of inhomogeneities, such packets may close on themselves. Such a wave we will call, for brevity, "**clowatron**".

The sizes of the clowatrons can be very diverse - from the giant spherical clusters of galaxies mentioned above as acoustic oscillations of the Universe [10], to nanometer ring structures leaving point traces similar to those for particles in detectors. Such closed waves also differ from each other not only by the frequency, amplitude and phase of the wave, but also by the equivalent diameter of their orbits, the orientation of the rotation axes, the mutual position, the spiral pitch, the direction and rotation speed of its polarization plane, etc. They can be



Fig. 4. Trajectory of the toroidal wave

standing or running (with speeds reaching the speed of light), spherical, cylindrical or flat (depending on the shape of the wave front), longitudinal, transverse or mixed (depending on the ratio of elastic moduli), plane or circularly polarized. Accordingly, the shape of such ring structures varies from spherical waves [18] to "twisted" (with a spiral wave front) [19], and from them to waves of the toroidal form, the wave motion in which can be decomposed into equatorial (in the circumference of a larger radius) and meridional (along a circle of small radius) [20] (Fig. 4).

Due to this variety and the possibility of counter-directional movement, the wave model of a substance is capable of reflecting any (mechanical, thermal, electrical, magnetic, chemical, etc.) properties of substances, as well as a difference in the charge sign, spin, "northern" and "southern" poles, etc.

The main difference between the wave model of the structure of matter consists in taking into account the spatial extent of any part of it and its internal structure. This dramatically brings these models closer to reality. Another difference is in the recognition that the wave moves not matter, but only the front of the wave. This removes the contradictions associated with the impossibility of the appearance of a vortex motion in an environment devoid of viscosity, and the inevitability of damping of the vortex motion in the presence of such a viscosity.

The wave model removes the limitations associated with the requirement of the balance of the centrifugal and centripetal forces acting on the particle, as required by the corpuscular model. A standing wave itself localizes the zone of a stable position of its material carrier (structural element of matter), which corresponds to the antinode of the wave, since in the antinode of the wave the force acting on it is zero. This explains why not only the elementary "particles" of matter, but also planets, stars and galaxies are located at a certain distance from each other, a multiple of the wavelength [20]. This mutual arrangement remains in the conditions of the motion of the body as a whole, which explains, in particular, the invariability of its chemical properties in the variable external fields.

The absence of a requirement for a balance of centrifugal and centripetal forces removes the limitations on the construction of theoretical models of the microworld and allows us to consider various variants of non-planetary models of atoms and molecules as structural units of matter. With this approach, it is completely permissible, for example, the layered shell and shell-node model of the atom, as well as its ring-shaped model, in which the plane of the ring wave lies outside the nucleus of the atom (Fig. 5).

The toroidal structure of the waves, in which the wave is observed to move along a spiral (both in the large and in the small circle), explains the occurrence of longitudinally-transverse

(mixed) waves in non-baryonic matter¹⁾. This means that the "luminiferous medium" carrying transverse waves does not necessarily have to be an electromagnetic field. This role can also be performed by non-baryonic matter, which essentially represents the same ether, which additionally possesses gravitational properties. Such an explanation is more adequate than the assumption of the presence of an ether, a gas of photons or a physical vacuum of electrical and magnetic properties. It is also confirmed by the fact that in the "dark" areas of the universe, where the proportion of non-baryonic matter approaches 100%, there simply is not room for these fields.



Fig. 5. The ring-shaped model of an atom (the nucleus is not shown)

4. Conclusions and their experimental confirmation

In addition to the experimental facts mentioned at the beginning of this article, which testify to the presence of density waves in outer space [8.9], we point out those that relate to the world of microparticles. These are photographs of graphene (Fig. 6) and a number of atoms (Fig. 7), obtained with the help of a scanning tunneling microscope (STM). As follows from the photographs, their structure is very far from the planetary model of Rutherford.

Among the many other consequences that follow from the wave theory of the structure of matter, we first of all note those that "contribute to a great extent to the achievement of the unity of our picture of the world" [1]. So, from the wave theory it follows that in nature there are no special "strong", "weak", "electric", "magnetic", "biological", "torsion", "information", etc. interactions - all of them are due to the same reason: the presence of an energy gradient in the mass dynamical field, which Rene Descartes called "thin" matter or ether, and de Broglie - "the field of matter". The strength of this interaction depends not on its nature, which is unified, but on the magnitude of the energy gradient in this field (the "steepness" of the front of its wave at a particular frequency), and its long-range action depends on the properties of the medium of propagation of its perturbations. The difference in the sign of the density gradient of this field deprives the mass dynamical forces of the exclusivity of gravitational forces and opens the direct path to the "great unification" of gravity with electromagnetism, and more generally to the construction of a "unified field theory".

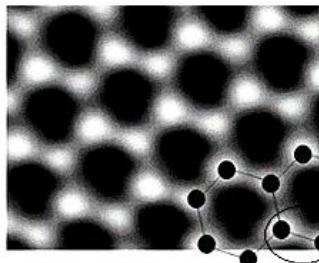


Fig. 6. Photo of graphene obtained with the help of the scanning tunnel microscope

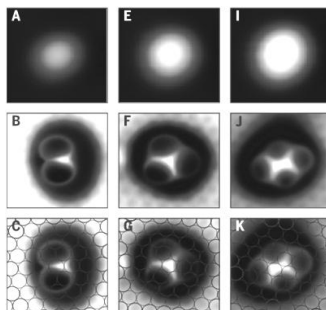


Fig.7. Photos of atoms obtained with the help of the scanning tunnel microscope

The heuristic value of the wave concept of the structure of matter also lies in the fact that it frees us from violence over common sense, logic and established concepts in asserting the existence of negative energy, the presence of "antimatter," the transfer of electromagnetic energy by particles devoid of electrical and magnetic properties, About the interaction and interference of a single particle with itself, about the emission of particles with light speed, bypassing the process of their acceleration, about the "instantaneous" (durationless) "jump" of an electron from orbit to orbit, simultaneous passage of a particle through several slots, The energy of the physical vacuum in its lowest energy state, the materiality of the force fields, the possibility of moving backwards in time, etc.

¹⁾ The trajectory of such a longitudinally-transverse wave resembles a river bed with an uneven bottom flowing between steep banks.

At the same time, the wave theory of the structure of matter makes it possible to explain the stability of atoms without resorting to the condition of the subtlest balance of dissimilar forces of unknown origin. She explains why electrons, for example, are scattered on obstacles as if they consist of concentric zones (bands) of elasticity, spaced from each other at a distance multiple of the de Broglie wavelength [20]. This concept on a specific example of the Planck radiation law shows why a radiation quantum should be considered a wave that is explicitly discrete both in time and in space [21].

It fills with a new meaning the concept of short-range interaction, which unlike the model of "exchange interaction" does not violate Newton's third law in the intervals between the acts of emission and absorption of particles - carriers of interaction. This concept sheds new light on the phenomenon of the so-called "quantum entanglement" (connectivity) of objects of the microworld, which can not be explained within the framework of the exchange interaction. The fact is that in the wave any pair of opposing forces (Fig. 3) arises and disappears simultaneously. Therefore, the material objects that are separated in space under the action of this pair of forces change their state also simultaneously without any transfer of information from one of them another.

All this confirms the fundamental nature of the wave theory of the structure of matter and opens up new possibilities for science in understanding the secrets of nature.

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