

Holographic Principle as the Basis for the Existence of Physical Reality

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Abstract

The article considers the physical model and presents the theoretical justification of the holographic principle of organizing the structure of the space. The physical mechanism of copying-incarnation is proposed, which allows to continuously reproducing the energy-information object as a projection of a holographic wave matrix. Based on the fractal principle and the iterative cyclic algorithm, the functional model of implicative consciousness is considered. It is proposed to consider dark energy as the basis of the energy of the Hologram, which is concentrated in the energy of elastic deformation of the structural elements of the phase medium, and which manifests itself in the form of oscillations of spherical longitudinal waves at discrete frequencies. The physical model and the mechanism for forming the separation boundary between the elements of the environment that form the structure of the object and the environment itself are presented.

Keywords: holographic principle, copying-incarnation mechanism, implicative consciousness, fractals of space-time, dark Energy, separation boundary medium/matter.

Introduction

This article continues the series of works under the general title "Physics of Reality". Recall the main conclusions made in the previous article [1]. **Space** is a homogeneous elastic structure or phase medium consisting of single quantum resonators in the form of **m**-cavities. **Matter** is a modified medium in the form of an elastic structure consisting of a certain set of structural elements - quantum resonators, which, depending on the density of matter, have a different degree of deformation and a different degree of synchronization of vibrations. **Inertia** is a manifestation of the elastic properties of a phase medium associated with a slowdown in the rate of transfer of energy of the angular-momentum between structural elements belonging directly to the body.

4. Material world from the Hologram

When considering the process of the birth of matter from a phase medium, the authors used the new term "wave matrix". This concept can be identified with the existence in the structure of space of a certain program shell containing a program for the embodiment of matter. In the generally accepted view, the "software shell" and the "object" itself, as a product of the program's implementation, represent different levels of physical reality. That is, if the "object" is a physical body or process, then the "software shell" is something virtual, existing independently of the object and structurally unrelated to it. However, according to the definition in the framework of the proposed concept, matter is a modified medium, that is, in the structure of the phase medium, both levels of physical reality are united by a common physical mechanism. In this sense, speaking of the wave matrix, we should expand this concept and consider the wave matrix as an element of the multidimensional structure of the geometric field of spatial frequencies, that is, as an element of *the Universe's Hologram*.

One of the first who proposed a similar concept of the structural basis of physical reality was the outstanding 20th-century English physicist **David Joseph Bohm**. According to his hypothesis, the Universe is a giant fluid Hologram or "holomovement" in which the World exists simultaneously in two realities - it is the material world itself and a certain structure that defines the general order, which exists in some implicit form in each area of spatial-temporal continuum [2].

What is the essence of this not accepted and obscure concept by David Bohm, moreover, greatly damaging his impeccable reputation as a theoretical physicist at that time? According to Bohm himself, the described order can be a projection of higher volumetric levels of reality, in which the apparent stability and hardness of objects and creatures is created and maintained thanks to the continuous process of *clotting - deployment*. In this process, subatomic particles belonging to object reality are constantly "clotting" into a hidden order, and then *recrystallization* (restored).

Having proposed the hypothesis of the holographic principle, David Bohm was unable to develop a physical model that would explain the *clotting - deployment* mechanism, due to which matter acquires the properties of solids. David Bohm believed that the process of cyclical "erosion" of matter into a *hidden order* (clotting) and subsequent restoration (deployment) of an object proceed in an **absolute emptiness** without material intermediaries.

As known, the absolute emptiness of space is postulated in the official Paradigm, and in this sense, the David Bohm hypothesis, despite its novelty and revolutionism, is no different from other official hypotheses and theories. After all, a similar approach is used in almost all theories from quantum mechanics to cosmology.

So, for example, to explain the mechanism of interaction between stationary charges, it is proposed to allow the existence of a certain "physical agent" in the form of an electric field, which is given the definition of "a special kind of matter". It is through this "agent" that the force interaction between electric charges is allegedly carried out. In other words, the concept of *absolute emptiness*, which does not have a physical interpretation, is replaced, as applied to a certain local region of space, with a new concept: *a special kind of matter*, which again does not have a real physical model. It should be noted that the process of interaction through the field (and not only of electrical) is described and represented by many mathematical models and theories, based mainly on empirical dependencies obtained experimentally.

A similar situation arises when one tries to explain the behavior of particles inside atomic nuclei by the presence of "strong interaction". Given the ratio of the size of atomic nuclei to the size of particles, this type of interaction also occurs through the void inside the nuclei themselves. But unlike charges, the interaction between particles occurs without material intermediaries, that is, in this case, a "physical agent" is no longer required to explain the mechanism of interaction.

An equally illustrative example is the theory of propagation of electromagnetic waves by Maxwell. Being a supporter of the existence of the ether, Maxwell very originally circumvented a number of contradictions inherent in both the theory of ether and the official paradigm. By proposing to introduce the dielectric and magnetic constants of vacuum, Maxwell actually postulates the same macroscopic void, endowing it with the properties of matter.

If we turn to the scale of outer space, then the same picture is observed here. For gravity, the hypothetical particles of gravitons interacting in a vacuum through collisions are responsible. Classical physics considers gravitational waves to be plane, transverse waves, offering gravitons as an intermediary - a carrier of gravitational interaction.

And the question is, - *Are gravitons responsible for the appearance of the gravitational field of massive bodies?* - Remains open, since in the absence of experimental data confirming the existence of gravitons, it is impossible to understand either the mechanism of the emergence of a potential gravitational field or the phenomenon of propagation of *gravitational waves* in an absolute emptiness. Moreover, limiting the speed of propagation of gravitational waves to the velocity of light, it is argued that the interaction itself is carried out with infinitely high speed. The experimentally confirmed fact of the instantaneous action of gravitational forces makes us once again doubt the validity of the official paradigm based on Newton's theory of gravity and Einstein's theory of propagation of gravitational wave.

Returning to David Bohm's hypothesis, it should be said that, having failed to find a physical mechanism for maintaining "order" at the programmatic level of reality, David Bohm decided to turn to metaphysics for help, assuming that, *"consciousness has much more hidden order than matter, and in this sense, at a deeper level, they (matter and consciousness) are actually intertwined and inseparable in joint participation in the cycle of reproduction of physical reality. From this point of view, mind and matter are two facets of one whole, which are inseparable, as form and content."*

It is consciousness, according to David Bohm, that lies outside our level of reality (read, outside our understanding) and, existing in a deep implicative (hidden) order, controls other forms of matter. The metaphysical nature of such an assumption is obvious, therefore, in the scientific world, his hypothesis has been dubbed as difficult to understand and not having practical application. Against this background, the holographic principle proposed by David Bohm, without losing its relevance, requires further development in relation to all areas and applications of modern physics. To understand the essence of this principle, let us consider the mechanism and the basically similar physical model used in Holography.

The mathematical theory of holography appeared much earlier than its practical implementation and obtaining holograms. The discovery of the "holographic method" belongs to British physicist Dennis Gabor (1947) and was an unexpected result of research to improve electronic microscopes. As is known in Holography, the image of a 3-dimensional object is first recorded on a photoplate in the form of a two-dimensional interference pattern. The phase relations of the wave reflected from the object (object wave) are recorded on the plate relative to the reference wave coming directly from the source. When a photoplate is illuminated with a light wave from an external source that is close in frequency to the reference one, that is, the one used during recording, images are restored in the form of a three-dimensional projection of an object that is highly similar to a real object. It is obvious that for the holographic projection process, in addition to the object and its copy recorded on the photo plate, an external reference radiation source is required.

To revitalize the hologram, it is necessary to implement a frame recording of the object in motion and the subsequent reproduction of the sequence of frames. For this, wave matrices recorded with a period of standard frequency equal to 60 frames per second must be reproduced using a special projector in the form of a holographic projection; which will allow us to "revive" the hologram. It was possible to realize such an idea thanks to the use of semiconductor CCD arrays for recording holograms. A sequence of wave matrices stored in digital form is reproduced using a Spatial Light Modulator (SLM). As a result, it becomes possible to observe in motion a very real copy of the image of the object in the form of a hologram projection.

Now we move from 3-dimensional space to 4-dimensional. But unlike David Bohm hypothesis, we immediately place both levels of physical reality in a phase medium. Next, imagine that we added at the time of "recording" to our original wave matrix of the programmatic level the 4th component - Time. That is, the process of "recording" the wave matrix is now combined with the process of its "reproduction" in the recording-reproduction cycle. The resulting projection of the wave matrix, as a result of the interaction of the space of bodies with the space of events, will turn out to be three-dimensional, and Time will be present in it as a sequence of two-dimensional matrices in the structure of spatial frequencies.

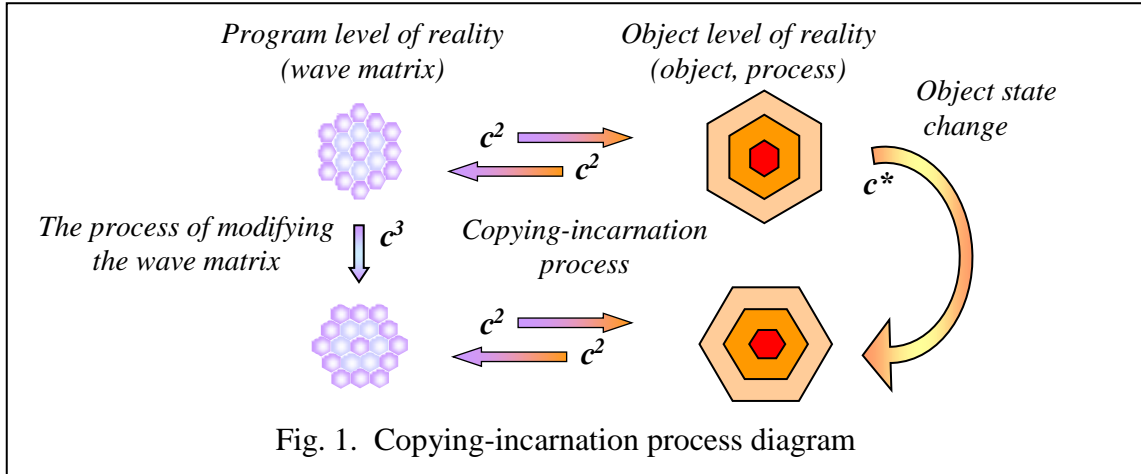
Next, imagine that the recording-reproduce process occurs in a continuous mode, but not with a frequency of 60 frames per second, but with a *copying-incarnation* frequency corresponding to the frequency of the red border, that is, the frequency incarnation of the electron. Thus, in the structure of space-time, a mechanism will be launched that allows to continuously reproduce the energy-information object as a projection of a holographic wave matrix. In other words, both the wave matrix at the programmatic level of reality and its materialized projection at the physical level of reality (in the form of elementary particles, atoms, crystal structures and molecules) will exist in the general structure of the geometric field of spatial frequencies. Accordingly, any changes in the structure of the object under the influence of external factors are instantly reflected (according to the feedback principle) in the change in the wave matrix at "*the programmatic level*", and are also instantly incarnation as a new state of the object at "*the objective level*". That is, the object and its wave matrix are different phases of the copying-incarnation cycle.

The process of changing the state of an object, for example, in the process of movement of an elementary particle, can occur at the object level with the velocity of light. The object level is characterized by the period of the cycle of reproduction of matter: $\tau_e = 0,4017 \cdot 10^{-20}$ (sec), which is determined by the frequency of the red border: $\nu_{rb} = \nu_e = 2,4892 \cdot 10^{20}$ (Hz) [1]. However, each subsequent incarnation of a particle cannot take place until its wave matrix is changed. That is, both the cycle period and the phase delay will be determined not by the velocity of the direct process at the object level, but by the velocity of information transfer in the feedback circuit, which in turn depends on the velocity of the process of modifying the wave matrix.

If, however, we take into account that all processes are synchronized in the interference structure of spatial frequencies, then the phase delay value cannot exceed a certain value, which is somehow related to the quality factor of oscillatory systems in the structure of an object. At the same time, the phase delay, taking into account the allowable deformation of the structural elements of the phase medium, will be physically limited from below by the angular-momentum transfer rate during the modification of the wave matrix.

The operation of the *copying-incarnation* process algorithm can be represented in the form of a circuit, Fig. 1. The first thing you should pay attention to is the structure of velocities in exchange processes. Such a distribution of speeds can be explained in the framework of a mathematical model of an automatic control system with a multi-loop feedback system. It is known that for the stable operation of such systems, the flow rate of information in the feedback circuit should always exceed the velocity of the process itself. This speeding ultimately determines the stability of any element, as well as the System as a whole. That is, if the maximum velocity with which a certain process can proceed at the *object level* is equal to the velocity of light c^* , then the speed of the energy-information flow in the feedback circuit of this process, taking into account the phase delay, cannot be less than $\sim c^2$, otherwise the process will simply "fall apart".

Within the framework of the model under consideration, the feedback chain for the object level of reality should be considered the chain of the copying-incarnation process. In turn, the copying-incarnation process itself also has its own feedback loop, due to which the modification of the wave matrix is ensured. Accordingly, the velocity of the process in the feedback loop of the wave matrix modification should not be lower than $\sim c^3$, That is, the whole process of materialization of the wave matrix proceeds, as it were, in two stages and is covered by two loops of the feedback system.



For a physical model, it will be more correct to represent the ratio of velocities as the ratio of frequencies. We introduce the notation; ν_e - frequency of copying-incarnation (object level of reality); $\nu_{eG} \approx \nu_e \cdot 10^8$ - is the frequency of modifying of the wave matrix (software level of reality); $\nu_{eGH} \approx \nu_{eG} \cdot 10^8$ - is the frequency of interaction between the elements of the wave matrix. According to the proposed algorithm, the interaction through the feedback loop of the software shell with the level of object reality is carried out at the frequency ν_{eG} . Accordingly, the clock frequency of the functioning of the "program" itself should be not less than the frequency ν_{eGH} .

It is no secret that in most cases modern physics does not consider it necessary to take into account feedbacks and considers any process as a process of *direct action*, the velocity of which is limited by the velocity of light. However, it is thanks to the energy-informational exchange between objects, structures and processes that the material world exists. Therefore, to the question, - *Does the photon flying out from the Sun know that it will fall precisely into our detector?* One can only answer in the affirmative, - *Yes, he knows it!* And the photon "receives" this information almost simultaneously with the start of the "movement". This simple example allows us to understand the meaning of feedbacks even where it would seem that they should not be, and they can be ignored.

Obviously, when the particle structure itself is a modified medium, it is possible to talk about the movement of particles in the real world only as a sequence of copying-incarnation cycles in an elastic medium [1]. In fact, the registration of the motion process is a fixation with the help of detectors the process of excitation of an elastic medium in the form of a sequence of acts of angular-momentum transfer at a speed limited by the velocity of light. In this case, we can say that the photon from the Sun at the time of its generation transmitted a command to its clone via the feedback circuit. After that, the clone of the photon in our detector materialized in the form of a projection of a new state of the holographic structure of the wave matrix, which belonged to that particular photon generated on the Sun.

Based on the presented model and, returning to the David Bohm hypothesis, we can confirm its correctness and claim that the physical form of the existence of physical reality is a materialized projection of the wave matrix in the cyclic process of copy-embodiment. The structural and physical basis of the energy-informational wave matrix is the energy quantum.

That is, the program shell is formed from a regular structure, which has an initial structural level in the form of an energy quantum (a kind of space's pixel) with a characteristic size of 10^{-34} (m). Accordingly, the basis of the structure of the phase medium or the fine structure of the Space is a single quantum resonator or m-cavity with a characteristic size of 10^{-37} (m). In other words, the fine structure is the very "bricks" that make up not only the energy quantum, but also *material objects* from elementary particles to planets and galaxies. The process of forming a fine structure is based on a number of properties of the space [1], which are:

- The presence of longitudinal spherical excitation waves at the resonant frequencies of the medium element;
- The multidimensional symmetry of the space, due to which moment-momentum energy is transferred in any direction from element to element without loss;
- The quantum nature of the excitation's mechanism and transmission of the angular momentum energy.

It is obvious that the indicated properties of the space and the functioning of the considered copying-incarnation mechanism become possible only in the presence of oscillations of **longitudinal spherical waves** at discrete energy-carrying frequencies. That is, in the phase medium itself at all large-scale levels of physical reality, there must be a mechanism for generating and maintaining discrete reference energy-carrying frequencies. It is also obvious that longitudinal waves can exist only in an elastic medium that allows compression and tension.

Therefore, the recognition of the existence of such an environment means the recognition of the *Absolute Reference Frame*, which is also equivalent to the proof of the existence of a multidimensional structure of the geometric field of spatial frequencies or of the **Universe's Hologram**. In other words, the elastic phase medium and the absolute void are mutually exclusive concepts. In this sense, adhering to the official paradigm about absolute emptiness, physical science is driving itself into a dead end and it has no choice but to deny Boom's hypothesis, and therefore the *holographic principle of organizing the structure of space*.

The existence of an integrated system for generating discrete energy-carrying frequency frequencies, which we have yet to return to, is connected not only with the need to maintain the structure of the Hologram. In fact, the considered principle and physical mechanisms are just tools that allow you to realize the main idea of the evolutionary development of physical reality - the idea of the existence of a *Creative Principle in the Universe*. David Boom considered it possible to assign this task to an implicative consciousness that governs all forms of matter and has a higher level of hidden order than the "program level". Let us try to answer the question within the framework of the proposed physical model: - *Is there a built-in physical mechanism that can implement the "creative principle" algorithm in Nature and how does this implicative consciousness give rise to order from chaos?* But unlike the Boom hypothesis, we define this highest level of hidden order as a certain functional mechanism based on the fractal principle of the formation of any spatial structures and objects from the phase medium as space-time fractals.

5. Fractals of space - time

Unlike David Bohm, the famous physicist **Benoit B. Mandelbrot** did not offer revolutionary hypotheses about the structure of the Universe; his approach was to study structures characteristic of living nature. His fundamental work "*Fractal Geometry in Nature*" [3] was, in a sense, a good experimental confirmation of the developed Theory of fractals, which appeared later. Although in fairness it should be recognized that the mathematical base for the appearance of this theory was laid many years before the birth of Benoit Mandelbrot.

A fractal depicting the Mandelbrot set on the complex plane is the set of points c for which the iteration sequence function, defined as: $f_c = z^2 + C$; $z_0 = 0$, $z_1 \rightarrow z_0^2 + C$..., $z_{n+1} \rightarrow z_n^2 + C$, is finite (that is, it does not go to infinity). Each consecutive value of z is obtained from the previous one; the complex number C is called the control parameter. The behavior of a sequence of numbers depends on the parameter C and the starting point z_0 . The Mandelbrot set can be obtained if the parameter C is sequentially changed in an iterative cycle with a fixed value $z_0 = 0$. Visually, the Mandelbrot set looks like a set of an infinite number of different figures, the largest of which is called a cardioid. The cardioid is surrounded by ever-decreasing circles, each of which is surrounded by even smaller circles, etc. With any increase in this fractal, more and more small details of the image in the form of cardioids similar to the main figure will be revealed.

The mathematical algorithm proposed by Benoit Mandelbrot, being transferred to the physical model, allows not only to explain the natural mechanism for implementing the holographic principle, but also to endow this functional mechanism with the ability **to create reality**. That is, it allows explaining the ability of Nature to "consciously" reproduce (clone) the structure and characteristics of the "object", creating any number of clones at each scale level of object reality. In this sense, the program of the iterative algorithm based on the fractal principle built into the cyclic process of projecting the wave matrix allows us to remove metaphysics from the Bohm hypothesis by assigning to the iterative algorithm the control function of all forms of matter. It is in the structure of the **Fractal cyclic iterative Algorithm** that lies the very deep hidden order, which, according to David Bohm, is present in some implicit form in each area of space-time and which Bohm called "*holomovement*".

The fractal models that Benoit Mandelbrot examined were mainly two-dimensional, which was associated with the computational capabilities and the complexity of calculating spatial models. Modern mathematical methods and powerful computers today make it possible not only to visualize complex spatial fractal structures, but most importantly, they can be used to understand the ability of Nature to create. In this sense, a random set of objects and forms, in which chaos can often be seen, turns into a hidden order. This hidden order is present in all forms, objects and processes where Nature looks like the best designer, ideal builder and engineer.

Russian scientist **Gennady S. Melnikov** was one of the first to see the connection of the fractal structure of Nature with its ability to create order from chaos. G. Melnikov proved that by combining the theory of harmonic Euler series and the theory of Mandelbrot fractals, any spatial-temporal structure can be represented as a system of equations of the geometric field of spatial frequencies. That is, in the form of a holographic wave matrix, which will be the structural form of the "*hidden order*".

In the process of analyzing *the equations of the geometric field of spatial frequencies*, G. Melnikov developed the foundations of a theory that allows explaining the methods of organizing numerical systems and spatial structures as fractals-hypercomplex objects of non-integer dimension of space-time with spatial or spatially-temporal localization of similar elements in a common hierarchical iterative structure [4]. G. Melnikov proved that, based on the theory of harmonic series, it is possible to classify all spatial configurations and multidimensional structures using the generalized Euler characteristic:

$$N^d = \frac{T + F + R}{2} = R + I = T + F - I ; \quad (5-1)$$

here, N^d - is the number of symmetry information axes; T - is the number of vertices; F - is the number of faces of polyhedral structures and configurations; R - is the number of edges.

Melnikov's classification is based on a number of basic principles and provisions:

1. Spatial and spatial-temporal configurations, structures, and cyclic processes must be considered in multidimensional phase space: three spatial coordinates plus N - *spatial-temporal coordinates*, that is, *concentric spherical shells*, each of which is locally orthogonal to each of the spatial coordinates X, Y, Z .
2. Any spatial configuration, multifaceted structure, or cyclic process (let's call them objects) in such space-time have dual infinite hypercomplex mappings, both into external and internal spaces of objects.
3. The descriptions of these objects obey the equations of the geometric field of spatial frequencies, which are based on complex functions and complex half-numbers, and the visualization of objects and their representations in a two-dimensional plane is carried out using parametric representations and conformal projections of objects in coordinate systems of phase space-time.
4. All regular structures, configurations and processes are objects of space-time and have a fractal nature, both numerical and spatial-temporal.

Consider the features of some sequences based on harmonic series, taking into account the principles and provisions proposed by G. Melnikov.

The harmonic thinned series or Kempner series. If we consider a harmonic series in which only terms whose denominators do not contain the number 9 are left, then it turns out that the remaining sum converges to the number <80 . Moreover, it is proved that if we leave the terms that do not contain any pre-selected sequence of numbers, and then the resulting the series *will also converge*.

Random harmonic series deserve special attention. In 2003, the results of a study of the properties of a random harmonic series were published [5]. In these works, it was shown that the harmonic series:

$$\sum_{n=1}^{\infty} \frac{S_n}{n} ; \quad (5-2)$$

here, S_n - are independent, identically distributed random variables that take values $+1$ and -1 with the same probability of $\frac{1}{2}$, converge with probability "1" and the sum of the series is a random variable with interesting properties.

For example, the probability density function calculated at points $+2$ or -2 has the value: $0.1249(9)$, differing from $\frac{1}{8}$ by less than 10^{-42} . The probability density calculated for other points also takes on certain values with a probability of "1".

In accordance with the theory of G. Melnikov and the presented classification of spatial configurations and cyclic structures, a very unexpected but unique conclusion can be made. Of all the possible combinations, the Mega System, being based on resonant structures obeying the laws of random and thinned harmonic series, can itself reproduce any spatial and spatial-temporal object with a probability of unity by implementing a **fractal cyclic iterative algorithm** with turning off one or more components of a harmonic random series.

Moreover, the very way of "making a decision" to turn off one harmonic or another is embedded in a multi-circuit network structure of feedbacks that ensure the survival of the object in the process of executing the iterative algorithm. In other words, as a result of the interaction of oscillations at resonant frequencies with the "switching off" of harmonics, only those objects that correspond to the laws of symmetry of the Mega System remain "stay alive". Starting from the structures of elementary particles known to us and ending with galaxies and other objects, including those fundamental constants that were determined as a result of the self-organization of the Mega System at the "moment of its inception". Including a distributed structure of generation and support of discrete energy-carrying reference frequencies.

The presented space structure based on a multi-loop feedback system and supporting the operation of a fractal cyclic iterative algorithm, has all the features of *a neural network*. A distinctive feature of such networks is their mobility and adaptability, that is, instant modification of the network structure at any scale level depending on the presence or absence of one or another "signal" in the feedback circuit. Thus, the presented network structure can be defined as the highest level of the hidden order or implicative consciousness that governs all forms of matter. At the same time, the control functions of implicative consciousness are combined with the process of materialization of objective reality in the copy-embodiment cycle. In this sense, relying on the presented physical model and thus removing metaphysicality from David Bohm's hypothesis, we can repeat his words and say, that "... *mind and matter are two facets of one whole, which are inseparable in Nature, as content and form.*"

6. Dark energy - the energy basis of the Universe's Hologram

The postulation of the holographic principle of the organization of the structure of the Space requires answers to a number of questions:

- What type of Energy does the natural mechanism use when forming the structure of the phase medium?
- What is the source of oscillations, and what is the mechanism for generating the absolute scale of discrete reference frequencies?
- What is the physical mechanism of the formation of a section boundary: medium / matter in a homogeneous elastic medium?

In the previous chapter, the position was postulated that the process of materializing the projection of the wave matrix is possible only if there are discrete energy-carrying frequencies in the structure of the Space. That is, in the phase medium itself at all scale levels of physical reality there must be a mechanism for generating and maintaining oscillations of *spherical longitudinal waves at discrete resonant frequencies*. This mechanism, being an organic element of the structure of the phase space, should be based on the fractal principle, which obeys the laws of the harmonic natural series, and in which the frequencies of two adjacent spectral ranges are correlated as 2:1.

This conclusion allows us to draw the results of many studies, including those conducted by Benoit B. Mandelbrot [3]. These studies were related to the structural phenomena and processes observed in Nature, for which one way or another the specified octave principle is the basis for the formation of fractal spatial objects. According to the laws of constructing harmonic series, in the structure of frequency generation, each spectral range within an octave will begin with an energy-carrying frequency. The distribution of frequencies within the range will be subject to a tempered harmonic series.

The frequencies of the tempered harmonic series are calculated according to the formula:

$$v_{e(i+1)} = k \cdot v_{e(i)}; \quad (6-1)$$

here, $k = \sqrt[n]{2}$ - is the tempering coefficient;

n - is the number of structural frequencies in each spectral range.

The indicated principle of forming a harmonic series can be extended to the entire frequency scale in all u^* spectral ranges - from ultra low to ultra high. Multiplying the reference frequency by the coefficient of tempering, we can calculate the next frequency of the range; and so on until the next reference frequency. Thus, one can calculate the tempered harmonic series for all spectral ranges, that is, to determine the spatial frequency grid of the spherical longitudinal waves of space.

We introduce the notation: \tilde{v}_{ij} of the i -th harmonic in the j -th spectral range. Imagine the frequency grid in the form of a matrix of dimension ($n \times u$). Where n - is the number of structural frequencies in each spectral range; u - is the total number of ranges.

$$A\tilde{v} = (\tilde{v}_{ij})_{n \times u} = \left\| \begin{array}{c|cccc} \tilde{v}_{00} & \tilde{v}_{01} & \tilde{v}_{02} & \dots & \tilde{v}_{0u} \\ \tilde{v}_{10} & \tilde{v}_{11} & \tilde{v}_{12} & \dots & \tilde{v}_{1u} \\ \tilde{v}_{20} & \tilde{v}_{21} & \tilde{v}_{22} & \dots & \tilde{v}_{2u} \\ \vdots & \vdots & \vdots & \tilde{v}_{ij} & \vdots \\ \tilde{v}_{n0} & \tilde{v}_{n1} & \tilde{v}_{n2} & \dots & \tilde{v}_{nu} \end{array} \right\| \quad (6-2)$$

To fill the matrix, it is necessary to determine the total number of spectral ranges u and find the "reference point" on the frequency axis in the known spectral range, that is, the frequency that allows you to answer the question, - *In which place of the spectral range is this harmonic located?* Then, having determined the reference frequency, according to the formula (6-1), it is necessary to calculate other frequencies of the selected spectral range and then find the multiple frequencies in the remaining spectral ranges.

Studies in this direction were successfully carried out by the authors, and the results will be presented in subsequent articles of this series of works.

The frequencies of the zero line: $\tilde{v}_0 = [\tilde{v}_{00} \tilde{v}_{01} \tilde{v}_{02} \dots \tilde{v}_{0u}]$ are responsible for the reference energy-carrying frequencies in each u^* of the spectral ranges. Separation of frequencies into reference and structure-forming frequencies is a prerequisite for the operation of the copying-incarnation mechanism. These frequencies separate the spectral ranges and functionally ensure the operation of the "software shell". In addition, they indirectly participate in the formation of a materialized projection of the wave matrix, that is, in the formation of the structure of matter. Separation of spectral ranges is provided by dedicated protected zones, which can be defined as free or "dark zones". Since it is precisely in the energy of oscillation of the reference frequencies that the energy called the *dark energy* of space is concentrated. Or to be more precise - this type of energy is the energy basis that ensures the formation of the Universe's Hologram.

For obvious reasons, such a definition of dark energy cannot be found in scientific publications that reflect the official point of view. Historically, dark energy got its name after conducting a series of experiments to observe supernovae (1990). It was found that the expansion of the Universe occurs with acceleration, therefore, considering that behind the creation of negative pressure supposedly causing the expansion of the Universe there should be some driving force, it was decided to call it dark energy. The existence of dark energy, confirmed by observations, and knowledge of the presence of dark matter has radically changed ideas about the composition of the universe. According to the latest data, dark energy makes up about 74% of the total energy of space; 22% is dark matter plus stellar matter, and only the remaining 4% is baryonic matter, that is, familiar us physical reality.

The physical model of space, based on the holographic principle of the organization of the structure of space and on the Theory of the phase medium, allows not only to interpret the concept of *dark energy* and *dark matter* in a new way, but also to evaluate the balance of energy and matter in the Universe in a different way. From the presented model, it becomes obvious that dark energy is the result of medium deformation during the oscillatory process at the frequency of the lowest-frequency harmonic in the structure of the reference resonant frequencies. Obviously, the degree of deformation, that is, the Energy of space for this harmonic is of the greatest importance and is estimated to be up to 10^{31} (J) per cubic meter of medium, which can make up the same 74% of the total energy of space according to the measured data.

To confirm our assumption, it is necessary to turn to the theory of harmonic series by Euler. According to the law of thinned harmonic series, any set of resonant frequencies must converge and have an important property in the ratio of the frequencies themselves for each spectral range of longitudinal waves generated in the structure of the phase medium. This property is associated with the need to maintain the *regularity* and *uniformity* of the fine structure of the space in the absence of energy consumption for maintaining oscillations.

These properties are possessed by standing spherical waves, which form tension-compression regions in the phase medium and have frequencies with periods that are multiples of two, that is, in accordance with the numerical sequence: 1, 1/2, 1/4, 1/8, 1/16, 1/32, etc. This sequence corresponds to a thinned harmonic series, the amplitude spectrum of harmonics of which is an exponential function, and the members of such a harmonic series will look as follows:

$$1 + \frac{1}{2} + \frac{1}{2^2} + \frac{1}{2^3} + \frac{1}{2^4} + \frac{1}{2^5} \dots + \frac{1}{2^{\tilde{u}}} + \dots \quad (6-3)$$

It is known that the radius of convergence of this series:

$$R = \lim_{\tilde{u} \rightarrow \infty} \sum_{\tilde{u}=1}^{\tilde{u}_{max}} 1 + \left(\frac{1}{2}\right)^{\tilde{u}} = 2 ; \quad (6-4)$$

here, $\tilde{u} = 1, 2, 3, 4, 5 \dots$ the total number of spectral ranges.

That is, this series will be limited by the number of terms to a value $\tilde{u} = \tilde{u}_{max}$, that corresponds to the last frequency range and determines the maximum resonant frequency $\tilde{\nu}_{m(max)}$ involved in the formation of the structure of the medium element. Now, if the first member of the series is equal to unity - this is the main harmonic (A_0) - then the amplitudes of the first (A_1) and subsequent harmonics ($A_{\tilde{u}}$) will decrease in accordance with the dependence for the exponential function. In this case, the sum of the amplitudes of all harmonics, starting from the 1st, will be equal to the amplitude of the zero harmonic (A_0). Accordingly, in the energy spectrum, the share of all harmonics except the main one will account for about 25% of the entire Energy of space.

This conclusion follows from the generalized Rayleigh's formula for the spectral density of Energy:

$$W_u(\omega) = |U(\omega)|^2 ; \quad (6-5)$$

The value $W_u(\omega)$ is called the spectral density of oscillation's energy $u(t)$ or the energy spectrum:

$$E_u = \int_{-\infty}^{\infty} u^2 dt = \frac{1}{2\pi} \int_{-\infty}^{\infty} W_u(\omega) d\omega ; \quad (6-6)$$

Relation (6-6) allows us to determine the total energy of oscillations in the medium, as a result of the contributions of individual harmonic components from different intervals on the frequency axis. Since the phase medium is a non-dispersing medium having the propagation conditions of longitudinal waves approximately the same in all spectral ranges, we can estimate the value of the instantaneous power of the space as:

$$P_H = \sigma_0 A_0^2 + \sum_{\tilde{u}=1}^{\tilde{u}_{max}} \sigma_0 A_{\tilde{u}}^2 ; \quad (6-7)$$

here: $A_0, A_{\tilde{u}}$ - are the coefficients of the Fourier harmonic series

σ_0 - is the loss coefficient associated with the elasticity of the medium.

Now, if we calculate the amplitude, $A_0 = 1$, then the sum in expression (6-7) is equal to:

$$\Sigma = p_1 + p_2 + p_3 + \dots = P_{\tilde{u}} = 0,33(3) ;$$

That is, in the power spectrum and, accordingly, in the energy spectrum, the share of all harmonics, except the zero harmonic, will account for 25% of the total energy of the space:

$$P_{\tilde{u}}/P_H = [0,33(3) / (1 + 0,33(3))] \cdot 100\% = 25\% ; \quad (6-8)$$

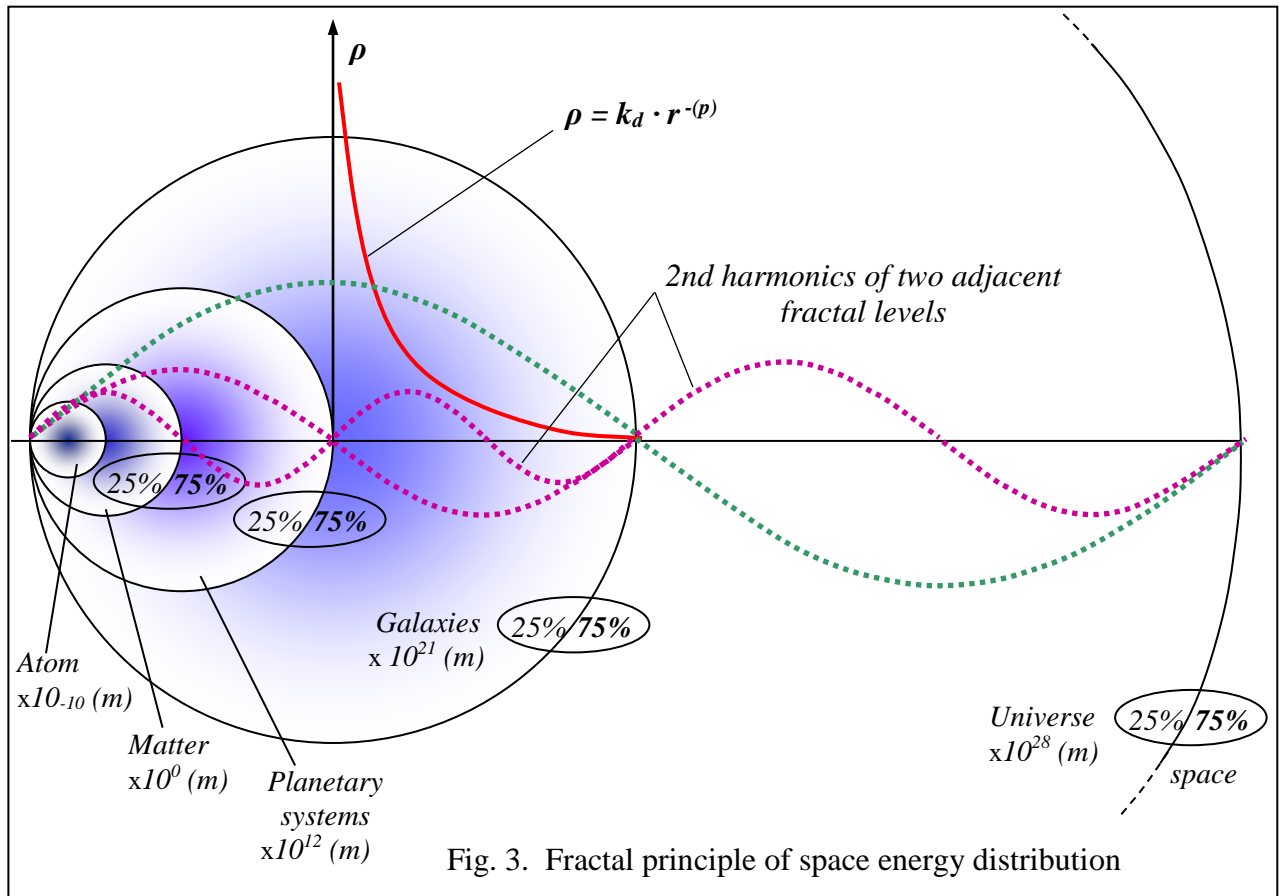
Accordingly, the remaining 75% can be attributed to the fraction of zero harmonic, that is, to the share of dark energy. Therefore, presenting a matrix of spatial frequencies (formula 6-1), we can say that "dark energy" in the form of a reference frequency is present in every material object, starting with the quantum of matter. The distribution of this energy in space obeys the law of natural harmonic series and is based on the Fractal principle.

Within the framework of the model under consideration, in favor of the existence of a periodic process, the fact of the expansion of the Universe with acceleration can also be attributed. Then for an elastic medium in the presence of a cyclic process of *tension - compression*, expansion with acceleration will mean that the Universe is currently at the beginning of the first quarter of zero harmonic (A_0). Provided that the reference point was taken to be the moment the maximum density of the medium was reached in the previous cycle of the "compression" phase.

Our calculations and conclusions can be illustrated in the form of a diagram, Fig. 2. The diagram shows the fractal principle of energy distribution of space. The proportions of the spheres are changed to simplify the graphical representation of the range of scale levels.

Obviously, the calculated ratio of energies will be performed at each scale level. That is, each sphere at its own scale level, which has 100% energy, contains the internal material structure of the next level, which accounts for 25% of energy. Thus, the fractal principle of energy distribution forms a *hierarchical structure of matter*, which, according to the theory of G. Melnikov, is a set of embedded concentric spherical shells in a multidimensional phase space. The number of a fractal levels can be determined by knowing the scale factor, which is calculated as the ratio of the size of the Universe: $H_M = 10^{28}$ (m), to the size of the quantum of matter: $\lambda_0 = 1,0153421 \cdot 10^{-34}$ (m) taking into account the size of the **m**-cavity: $\lambda_{m(2)} = 1,179228 \cdot 10^{-37}$ (m) [1].

The value of this coefficient: $M_F = 10^{65}$, being presented as the ratio of frequencies multiple powers of two: $M_F = 2^{216}$, allows you to determine the number of spectral ranges \tilde{u} in the structure of Spatial frequencies and the order of fractal levels u^* , i.e., $\tilde{u} = u^* = 216$.



Then the physical model of space, based on the theory of the phase medium, will be a fractal multiple structure consisting of self-similar elements in the form of spheres, the internal structure of which is characterized by a spatial phase gradient and is a frequency funnel bounded by a spherical shell with a variable phase gradient depending on the radius of the sphere that can be expressed by the formula:

$$\text{grad}\vec{\varphi} = \frac{\partial v / \partial \vec{r}}{\partial t} ; \quad (6-9)$$

here, $\partial v / \partial \vec{r}$ - is the single increment of the spatial frequency.

The value of the spatial phase gradient ($\text{grad}\vec{\varphi}$) can be identified with the *wave vector*, which in this case will characterize the degree of curvature of the Space inside each spherical shell. As you approach the center of the sphere, the density of the medium will increase due to an increase in the degree of synchronization of oscillations at the scale level of matter quanta. Depending on what scale level the sphere of the **frequency funnel** belongs to, the value of the gradient in the center of the sphere can reach large values, which creates the conditions for triggering the mechanism of matter generation. In addition, since each spherical shell is located in the center of a similar sphere of the previous level, due to the frequency-phase gradient at the boundary of the sphere, the phase medium is densified. This allows us to talk about the dynamic compaction of the medium at the boundary of the spherical shell and consider the density of matter a value equivalent to not only the number of synchronized elements of the phase medium inside the shell, but also the degree of deformation of the structural elements of the phase medium located on the boundary of the sphere.

The value of the density of the medium ρ inside an individual spherical shell will vary according to the law of a power function, which can be represented as a formula:

$$\rho(r) = k_d \cdot r^{-(p)} \quad ; \quad (6-10)$$

here, r - is the radius of the spherical shell; k_d - is the dimension coefficient.

The index of power (p) defines the steepness of the slope of the *frequency funnel* and thereby determines the size of the frequency funnel and the structure characteristics of the phase medium inside each individual sphere. Excitation inside the sphere of a standing spherical longitudinal wave occurs at frequencies corresponding to the reference resonant frequencies: $\tilde{\nu}_0 = [\tilde{\nu}_{00} \tilde{\nu}_{01} \tilde{\nu}_{02} \dots \tilde{\nu}_{0n}]$. The location of the nodes of the standing wave along the radius of the sphere is regulated by the steepness of the slope of the frequency funnel.

The considered principle of the formation of the hierarchical structure of matter allows you to save the unique properties of each object so that its internal structure and properties cannot be changed by external influence from the previous scale level. For example, an atom remains an atom in the structure of any matter, and the Earth, being in the center of its spherical shell in the structure of the solar planetary system, retains its unique characteristics, moving along a complex path with great velocity in outer space.

The generation of matter in the center of the frequency funnels is confirmed by the very fact of the existence of planets, planetary systems and galaxies. The magnitude of the phase gradients necessary to trigger the mechanism of matter generation can be estimated directly on a scale of fractal levels. For planetary frequency funnels, this value of the coefficient fractal levels is not less than: $M_F \geq 2^{53} = 10^{16}$. It is known that the Earth is constantly increasing in diameter. According to data obtained by NASA, the radius of the Earth increases at a rate of 2.8 ± 0.8 (cm / year). Consequently, the circumference of the globe increases on average by 17.6 cm per year and in less than 150 million years it has increased by at least 12,600 km.

That is, 150 million years ago, the diameter of the Earth was one third less. With the current diameter of the Earth 12,742 km, its surface area is, $S = 0,51 \cdot 10^9$ km². Thus, at the existing average speed of increasing the radius of the Earth by 3 cm / year, mass generation is, $0,5 \cdot 10^6$ (*five hundred thousand*) tons per second at a density of 1 ton / m³. That is, provided that the hydrogen generated in the center of the Earth's frequency funnel is partially involved in the synthesis of water on the way to the Earth's surface. Obviously, when hydrogen and carbon combine, the synthesized product may be methane gas.

According to the classical definition, Energy is a measure of the transformation of one form of motion of matter into another form. For the energy of space, such a definition means that in a phase medium a *quantum of energy* as a primary element of the structure of matter and as a structural element of the Universe's Hologram should be part of a continuous harmonic process. This process is supported by the physical mechanism of the reversible transformation of one type of energy (one type of oscillation) - into another; electromagnetic energy in the form of a vortex structure, being a synchronized shell of a quantum of matter, periodically takes the place of the nucleus and passes into the energy of longitudinal waves, i.e. into dark energy, and then again becomes a shell. In this case, the state of the medium can be figuratively presented as flicker at the frequency of transformation of a matter's quantum. In this case, the quantum of matter will periodically become visible or will disappear, as it were, becoming a "dark". Obviously, with a random chaotic distribution of the phases of the oscillations of the quanta of matter, the specific energy of the space will be determined mainly by the strain energy, that is, the *dark energy*.

Thus, dark Energy is present at all scale levels of the space's structure: from the quantum of matter to the scale of the Universe and at the same time ensures the operation of the "software shell" at the level of reference frequencies, that is, it is the energy basis for the formation of the Universe's Hologram.

7. The formation of the border: medium - matter

The holographic principle of the organization of the structure of the space allows us to consider any process, one way or another connected with the transformation of matter, as a process of modifying the wave matrix, which is based on the *copying-incarnation* mechanism. The physical model of the modification process is based on the postulate that the phase medium is the only "building material" for both the wave matrix and its materialized projection in the form of elementary particles, atoms and molecules. Therefore, in the paradigm of the existence of a phase medium, all objects and processes should be considered as dynamic structures, the existence of which is based on a mechanism associated with the transformation of one form of energy into another its form. The only possible physical model explaining the transformation process is a model based on the frequency-phase mechanism for modifying the phase medium, including the process of forming the boundary: medium/matter.

Using the example of the process of production of an electron-positron pair ($e^+ e^-$) from a phase medium, we consider some principal points of this event, which under natural conditions occurs as a result of excitation of a phase medium by a gamma quantum with energy of at least:

$$E = h \cdot \nu = 2 m_e \cdot c^2 = 1,031 \text{ MeV} \quad (7-1)$$

here, h - is Planck's constant; ν - is the frequency of the gamma quantum;

m_e - is the rest mass of the electron.

The process of transition of gamma quantum energy to the energy of the excited domain area of the medium and the subsequent production of an electron and positron is accompanied by the launch of a mechanism that allows you to "connect" new objects to the system for generating of the reference energy-carrying frequencies. This mechanism in the hierarchical structure of matter is based on the resonance properties of closed spherical cavities, each of which is a kind of resonator tuned to one of the reference frequencies. Following the fractal principle of energy distribution, the core of the sphere in the structure of spatial frequencies becomes a source of oscillations of spherical longitudinal waves, that is, it begins to act as an energy source for objects inside the sphere itself.

The peculiarity of this process is that the boundary of the sphere of a newly born electron (positron) is formed as an amplification of the phase gradient, which arises as a result of a significant difference in the frequency of the *copying-incarnation* electron (ν_e) in comparison with the update frequency of its *wave-matrix* (ν_{eG}) in the frequency structure of the system feedbacks. Moreover, despite the fact that the frequency ν_{eG} is significantly higher ($\nu_{eG} \approx \nu_e \cdot 10^8$), both frequencies due to different propagation velocities have the same wavelength multiple or equal to the radius of the electron's sphere.

Thus, during the period of one cycle electron's incarnation, its wave matrix in the form of an external interference structure will have time to confirm its state 10^8 times. As a result of the interaction of these frequencies, an increase in the phase gradient and compaction of the medium at the boundary of the sphere occur, that is, a medium / matter interface is formed.

Conclusion

The holographic principle of the organization of the structure of Space proposed by David Bohm and the fractal principle of the structure of matter described by Benoit Mandelbrot are mutually complementary and can only be realized in the structure of an elastic homogeneous phase medium that allows tension and compression. This condition is also necessary for the formation and propagation of longitudinal spherical waves in a phase medium. In this sense, the form of existence of the physical world is presented as a materialized projection of the geometric field of spatial frequencies, based on the holographic principle and the built-in mechanism of copying-incarnation.

The dark energy or the strain energy of the structural elements of the phase medium is the energy basis of the Hologram in the form of reference resonant frequencies. The process of materialization of the Hologram is carried out through the mechanism of *copying-incarnation* in accordance with the principles of conformal projections. This process is characterized by an increase in the degree of synchronization of oscillations and the degree of deformation of the structural elements of the phase medium, that is, it is characterized by an increase in the density of the medium while maintaining the wave structure of matter.

The body mass in such a physical model can be represented as a measure that allows, according to the degree of synchronization of oscillations and the degree of deformation of the elements of the phase medium, to compare different levels of modification of the medium, linking these levels with different density of matter.

The presented results of theoretical studies demonstrate that in the paradigm of the existence of a phase medium, the so-called dark energy is an organic element of the structure of space; unlike the classical paradigm, for which the existence of dark energy is a fundamental problem, which in turn is closely linked to the task of searching for dark matter and the problem of the Big Bang Theory.

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