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Scalar Field and Time Quantum

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Abstract: *The paper analyzes modern views on the physics of time and the existence of the Big Bang, based on the theory of quantum gravity. It has been shown that the existing models of the creation of the Universe, including the model based on the theory of quantum gravity, do not make it possible to find the quantum of time. However, some of these models deny the possibility of the existence of the Big Bang. On the other hand, the model of the Universe with the minimum initial entropy (UMIE) satisfies the theory of quantum gravity and allows you to find the value of the time quantum. At the same time, it is shown that Planck's mass, length and time, as well as the constant h, are fundamental quantities, which all properties of the Universe depend on. The UMIE model shows that light atoms are created in stars and planets as a result of the radioactive decay of heavy atomic nuclei. It shows that the Big Bang, as shown by the Standard Model of the creation of the Universe, did not exist. However, there was the birth of the Universe as an integral part of the Super-Universe, into which the Scalar Field enters at a constant speed. It fills all the layers of the Super-Universe with matter with zero initial temperature. Taking into account the inhomogeneity of filling space with matter on large scales, the UMIE model shows that gravitational interaction at large distances manifests itself by a significant increase in the redshift of the emission spectra of galaxies. Finally, the UMIE model explains the nature of fundamental interactions and explains why optical astronomical observations can register only 5-8% of the real mass of matter in the Universe.*

Keywords: *Scalar Field, time quantum, stratified space, Big Bang, expansion of the Universe, black hole, space-time "atom".*

1. INTRODUCTION

The entire 20th century was devoted to the rapid development of quantum mechanics. But the problem of time has not been solved by this science. The reason was that the minimum time interval with which science had to deal was equal to nuclear time. This time is $\sim 10^{-23}$ s. Apparently, the time quantum should be several orders of magnitude less than this time. It follows from this that in quantum mechanics it can be assumed that time flows continuously at a constant speed.

The range of distances and times in the Universe has scales much wider than in quantum mechanics. Therefore, one could hope that the development of the theory of quantum gravity would make it possible to explain the physics of time and find the magnitude of the time quantum.

At present, there are many models of the origin and development of the Universe. However, the main attention is paid to the development of the Standard Model, which was initiated by G.A. Gamow based on A. Einstein's theory of general relativity and the experimentally discovered recession of galaxies.

Analyzing scientific information about the Universe, it should be noted that the Standard Model does not satisfy the results of astronomical observations.

According to the Standard Model, at first the Universe was in conditions characterized by the presence of high temperature and pressure in a singularity in which the entire mass of matter was concentrated. Then, after the Big Bang, the matter in it gradually cooled as the Universe expanded. This created elementary particles, then hydrogen atoms. Finally, because of fluctuations in the density of matter in the Universe, galaxies and stars were formed in them. Heavier atoms were created inside stars because of thermonuclear reactions.

G.A. Gamov model demanded answers to a number of important questions. In particular, if all matter was concentrated in a singularity, then why didn't a black hole arise? What defines the arrow of time?

Does the Universe have some boundary in space? Are the laws of thermodynamics fulfilled during the evolution of the Universe? If the Universe is limitless, why is it dark at night? Can space exist without matter? In addition, many other equally important and fundamental questions.

Since the Standard Model was developed on the basis of the general theory of relativity, taking into account information about the recession of galaxies, it did not introduce the concept of a time quantum.

Unfortunately, numerous models of the birth and evolution of the Universe bypass a number of these important issues and therefore cannot be acceptable, since they clearly contradict the laws of physics. There are attempts to remove some of the contradictions of the Standard Model. For example, an inflationary model of the Universe is being developed, the concept of black matter and black energy is being introduced. However, in this case, some contradictions are simply replaced by others. Therefore, the problem of the birth and evolution of the Universe has not been solved and remains extremely relevant.

Of course, not all scientists agree with the Standard Model. As result, they create their own models. In particular, plasma cosmologist Eric J. Lerner, author of "The Big Bang Never Happened: A Startling Refutation of the Dominant Theory of the Origin of the Universe" (1991), at the 235th meeting of the American Astronomical Society argued in his report [1] that there was no Big Bang.

The Big Bang model is based on the fact that, for unknown reasons, more than 13 billion years ago, the entire mass of the Universe was in a singularity in a very hot state (~10^{28} K [2]) and had an extremely high entropy ($S_0 = 10^{88}$ J/K [3]). As a result of the explosion, the substance scattered in all directions, gradually cooling. At the same time, electrons and protons were born, and hydrogen atoms were created from them. These atoms condensed into stars, in which helium was born as a result of thermonuclear processes, and then lithium and other nuclei of chemical elements. It is considered, that this model is confirmed by the presence of cosmic microwave background radiation [4–8].

For unknown reasons, in the presence of a very large entropy of the Universe, its structuring into galaxies, star clusters, and planetary systems occurs. All these processes occur with a decrease in entropy. The Standard Model does not answer the question: where will the excess entropy go. It is only considered that the grouping of matter in a galaxy, a star and a planet occurs because of quantum fluctuations, the scale of which is infinitely smaller than the size of galaxies.

Calculations carried out on the basis of the Big Bang made it possible to find the ratio of the number of chemical elements in the Universe. Comparing them with the data of astronomical observations, Lerner saw that in fact the number of light chemical elements is significantly less than the Big Bang model gives [9]. Comparing other predictions (he identified 18 predictions) of the Big Bang theory with observational data, he saw that they were also very different. From this, Lerner concluded that there had been no light elements at all since the beginning of star formation. At the same time, he believed that light elements appeared inside the stars. In addition, Lerner states that there are stars in the Universe 10 times older than the time from the Big Bang. And, finally, he does not agree with the expansion of the Universe, although he cannot explain the nature of the redshift in the emission spectra of distant galaxies.

I note that Lerner, like the author of this article, rejects the inflation theory of the Universe as a non-physical theory, as well as the concept of dark energy and dark matter.

Another group of astrophysicists, whose lead author is Bruno Valeixo Bento, who studies the nature of time at the University of Liverpool in the UK, has applied a new theory of quantum gravity. This theory is called the theory of causal sets. In it, space and time are divided into discrete elements of space-time, that is, the fundamental units of space-time or space-time "atoms" [10]. Bento and his collaborators found that most likely, the Universe had no beginning, and it had always existed in an infinite past and only recently evolved into what we call the Big Bang. They showed that the general theory of relativity, which describes the gravitational interaction in the Universe, cannot explain two singularities, one of which occurs when the Universe was created, and the other at the center of a black hole. Describing these singularities requires a quantum theory of gravity. This theory eliminates the big bang singularity problem, since singularities cannot exist in this theory. Matter cannot be compressed to infinitely tiny points - they can be no smaller than the size of a space-time "atom". And from this, the authors of the study conclude that the Universe has always existed.

2. WHAT DOES THE MINIMUM INITIAL ENTROPY MODEL OF THE UNIVERSE STATE?

In such a situation, the author decided to discuss the problem using his own model of the Universe with a minimum initial entropy (UMIE), which does not contradict the named physical principles and can unambiguously answer the questions posed [11]. The UMIE model proposed by the author is based on the Laws of similarity and unity in the Universe.

It is known that the Universe has a hierarchical structure, as the fulfillment of the Law of Similarity [12]. Moreover, in [12] the principle of hierarchical similarity was considered as a new fundamental law of physics. In addition, the Law of Similarity is unambiguously described using the Tree of Life, which allowed the author of monograph [12] to create a theory of hierarchical systems, as well as to create numerous schemes of free electron lasers. We use this information when modeling the processes of birth and evolution of the Universe.

Therefore, in accordance with the Law of Similarity, the birth of the Universe must be similar to intrauterine development and the birth of a child. So the Universe should be represented by a stratified Super-space, which consists of zero-dimensional space (World-1), one-dimensional space (World-2), two-dimensional space (World-3) and our three-dimensional space (World-4).

At the initial moment, all named spaces were represented by folded spatial coordinates of fundamental dimensions. The Scalar Field began to enter at a constant speed through World-1. At the same time, World-1, i.e. The World of the Time-Field is the state of the Primordial Vortexes, the beginning of the Vortex Movements or the Main Driving Force. Hence, it follows that the vortex structure of the Universe is determined by the Scalar Field. From birth to completion, the Universe is fractal, and these fractals rotate.

Simultaneously with the initial moment, all spaces began to expand. In World-2, one spatial coordinate, in World-3, two spatial coordinates, and in World-4, three spatial coordinates expand. In this case, all expanding spatial coordinates remain closed. Thus, one-dimensional space became a brane of two-dimensional space, two-dimensional space became a brane of three-dimensional space, and our three-dimensional space became a brane of four-dimensional space. Since all spatial coordinates remain closed, the corresponding spaces turn out to be closed, having finite "volumes": $2\pi R_2, 4\pi R_3^2, 2\pi^2 R_4^3$ for the one-dimensional, two-dimensional and three-dimensional "volume" of the brane, respectively.

The Scalar Field first fills World-2 with Planck particles (diones), and continues to fill in as the "volume" of this space increases. After reaching the stationary concentration of particles in World-2, the filling of World-3 with quarks known to us begins, and then of World-4. Thus, the singularity does not occur. In World-4, initially space was filled only with vacuum particles. After a time $\Delta t = 3 \cdot 10^{-5}$ s, the Scalar Field begins to enter World-4.

An important property of the Scalar Field is its ability to directly create particles of matter in all spaces of the stratified Super-Universe according to the formula $E = mc^2$. This is what it differs from the vector electromagnetic field by, which under certain conditions can create only a particle-antiparticle pair. Since there are no charges in World-1, the created matter must be electrically neutral. Moreover, this means that only clusters of particles will be created in World-4, which are characterized by zero values of charge, spin, etc.

In World-4 the Scalar Field creates with a constant speed $\upsilon_m = 10^{34}$ kg/s material particles – bineutrons in the singlet state. In this case, the initial density of the substance does not exceed the nuclear density [11].

From the value of the rate of filling World-4 with matter, one can find the value of the time quantum τ. During the time τ, $\upsilon_m \tau$ kilograms of matter will enter through World-1. Based on the uncertainty relation, we find:

$$mc^2\tau = \upsilon_m \tau c^2 \tau = \hbar = 1{,}0546 \cdot 10^{-34}\ J \cdot s,$$

$$\tau^2 = 1{,}17 \cdot 10^{-85}\ s^2, \quad \tau = 3{,}42 \cdot 10^{-43}\ \text{s}.$$

To continue consideration of the issue of the time quantum, let's pay attention to the Planck units [13,14].

Max Planck first proposed the system of Planck units in 1899 based on the speed of light, the gravitational constant and two new constants of the theory of thermal radiation introduced by him and (they differ from modern constants ħ/k and by dimensionless factors). Currently, Planck units are considered based on the equality of the Compton length and the gravitational radius of a black hole:

$$\frac{2\pi\hbar}{mc} = \frac{2Gm}{c^2}$$

From here

$$m^2 = \frac{\pi\hbar c}{G}.$$

Since the Planck units must be defined exclusively in terms of fundamental constants, thus becoming fundamental units, the proportionality coefficients are removed. Therefore, you can get the Planck mass, Planck length and Planck time:

$$m_P = \sqrt{\frac{\hbar c}{G}} \approx 2.176 \cdot 10^{-8}\ kg.$$

$$l_P = \frac{\hbar}{m_P c} = \sqrt{\frac{\hbar G}{c^3}} \approx 1.616 \cdot 10^{-35}\ m.$$

$$t_P = \frac{l_P}{c} = \sqrt{\frac{\hbar G}{c^5}} \approx 5.391 \cdot 10^{-44}\ s.$$

Comparison of the values of τ and t_p showed that there is a relation between them: $\tau = 2\pi t_p$. Therefore, we can assume that the time coordinate in World-1 is also twisted into a spiral with a circumference τ and a radius t_p. This result explains the physical meaning of Planck's time. The article [11] shows that Planck's mass and length are realized in World-2 as fundamental physical quantities. Planck's particles, being diones, are realized in the one-dimensional space World-2. The concentration of these particles is constant over time. The average distance between them is determined precisely by the value proportional to the Planck length l_p. In addition, the Planck length determines the radius of folded spatial coordinates in World-1[1]. Consequently, World-1 is a multidimensional fundamental sphere, characterized by 12 folded spatial coordinates and one temporal coordinate. Thus, Planck's mass, length and time, as well as the constant h, are fundamental quantities on which all properties of the Universe depend. They represent together the spatio-temporal "atom".

Therefore, the time coordinate in World-1 is folded into a spiral. The entry of the Scalar Field through World-1 follows this spiral, moving the flow of time with each turn of the spiral. Therefore, the flow of time is discrete. The Scalar Field, which is part of the Super-Universe, is responsible for its flow. The Scalar Field enters through World-1 at a constant speed. Therefore, time moves in our world at a constant speed. Since the value of the time quantum is less than the nuclear time by 20 orders of magnitude, the time discreteness is not felt in our world.

Considering the Law of Unity as the Highest Law of the Universe, we must take as a basis that the Field feels, controls and directs all processes in the creation of the Universe. It creates bineutrons in the vicinity of already existing nucleons. In this case, the initial set of nucleons will correspond to future stars and galaxies. In other words, the Scalar Field imposes a kind of matrix on space and in the right places forms real particles from vacuum particles, which will continue to act as the embryos of stars. Since the Scalar Field is responsible for particle-antiparticle annihilation, it can also generate this pair from a vacuum particle. Forming bineutrons in the vicinity of particles, the Scalar Field stabilizes the appearance of stellar embryos. After that, the antiparticle annihilates with one of the existing particles.

It was shown in [11] that the effective number of stars in the Universe with a mass equal to the mass of the Sun ($M_s = 1.99 \cdot 10^{30}$ kg) is $2.1 \cdot 10^{21}$. Since $10^{34}/(1.675 \cdot 10^{-27}) = 5.97 \cdot 10^{60}$ neutrons are born every second, then in the first second the mass of the future star will increase significantly (up to a value of about 10^{12} kg). In this case, the mass of the created nuclei can exceed the mass of the uranium nucleus. It is clear that such nuclei will be unstable. Protons and electrons will be born because of the radioactive decay processes of such nuclei. The number of cores will increase rapidly. Initially born substance will have zero temperature and minimum entropy value. In the course of the radioactive decay of heavy nuclei, the matter will heat up and thermal radiation from the embryos of

[1] If we take into account that matter is created in all layers of the Super-Universe, then we get the relation: $\tau = \pi t_p$. In this case, the quantities t_p and l_p will determine the diameter of the circle of folded coordinates of time and length, respectively.

stars will appear. Since these nuclei rotate rapidly, their shape is more like a disk than a sphere. The peripheral regions of the disk will break away from the star, creating satellites that will eventually turn into planets, asteroids, or comets [15, 16]. Thus, at the beginning of the creation of stars, they do not have hydrogen atoms, as Lerner points out. However, there are heavy nuclei of chemical elements, most of which are unstable when created. It is clear from this that the source of energy for the radiation of stars is the processes of heavy nuclei radioactive decay, but not thermonuclear reactions.

The development of the Universe will lead to the grouping of galaxies and the creation of large spaces, where there are practically no galaxies. In the region of galaxy groupings, the average density of matter can exceed the critical density value by one or two orders of magnitude. This will lead to a significant redshift of the radiation of distant galaxies, which is perceived by astronomers as the radiation of quasars at a distance of more than 12 billion light-years from the Earth. Sometimes redshift calculations show that galaxies are further than 13-15 billion light-years.

One more important conclusion can be made based on the UMIE model, which makes it possible to explain why astronomical studies fix only 5% of the substance that is necessary to explain the value of the Hubble constant. The fact is that astronomical research allows us to see only the past of galaxies, when their mass was small. At the same time, the gravitational interaction between galaxies is capable of fixing the matter density at a given time [17], which explains the average matter density in the Universe. The UMIE model gives an upper limit to the densities of matter found from astronomical observations - this is 8%.

3. Conclusions

Based on the analysis of the Standard Model of the creation of the Universe, the model of the creation of the Universe with a minimum initial entropy (UMIE), as well as modern views on the physics of time and the existence of the Big Bang based on the theory of quantum gravity, the following is shown.

1. The theory of quantum gravity shows that space and time must be discrete and there must be a quantum of space-time. In this article, the author showed that such a quantum really exists and estimated its value, determined through the Planck parameters. Thus, Planck's mass, length and time, as well as the constant h, are fundamental quantities on which all properties of the Universe depend. They represent a quantum of space-time all together.

2. Comparisons of the conclusions of the Standard Model with astronomical observations made in the literature indicate their significant differences, in particular in the number of light atoms. Therefore, it was concluded that light atoms are created in stars. The author showed that, according to the UMIE model, light atoms are created in stars or planets because of the radioactive decay of heavy atomic nuclei.

3. The UMIE model indicates that there was no Big Bang in the form described by the Standard Model of the Creation of the Universe. However, there was the birth of the Universe as a component of the Super-Universe, into which the Scalar Field enters at a constant speed, filling all layers of the Super-Universe with matter.

4. The UMIE model shows that the interaction between galaxies leads to non-uniform filling of space with matter. In this case, regions of space arise with a significantly (10-100 times) increased density of matter, because of which the magnitude of the redshift of the radiation of galaxies increases significantly. If we do not take into account the influence of gravitational interaction on the magnitude of the redshift, then we can conclude that the corresponding galaxies are located at distances that are much further than 13 billion light years.

5. The UMIE model explains the nature of fundamental interactions and explains why optical astronomical observations can register only 5-8% of the real mass of matter in the Universe.

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