

THE ORIGIN OF THE UNIVERSE WITHOUT DARK MATTER AND DARK ENERGY

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*This research is dedicated to Professor
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who is scientific mentor of Shamil Galiev*

This paper develops a model for the origin of the Universe, previously presented in publications [1–7], based on the existence of a pre-universe. The model does not utilize the Big Bang (BB) hypothesis. The dynamics of the Universe are explained by the constant conversion of its energy to mass and back, i.e., the transformation of bosons into fermions and vice versa. The emergence of space and time is also associated with the transformation of initial bosons into fermions. All this excludes the existence of dark energy (DE). The gravity and masses of bodies are linked to the velocity of their motion. The higher speed, the greater mass and the body's gravity. As a result, the need for dark matter (DM) is eliminated. The model also implies that the microwave background radiation arose in the first moments of the Universe. The Hubble tension problem is discussed.

Overall, the model describes the transformation of the Universe from an initial energy clot into material structures, specifically, into multivalued waves, vortices, and the seeds of future galaxies.

Keywords: Modern Cosmological Model, fine-tuning problem, pre-universe, Universe, Big Bang, hypothesis, energy, mass, particle-waves, bosons, fermions, multivalued waves, evolution, Galactic's, Hubble Tension, velocity cosmic objects, Newton's mechanics, Multivalued Universe.

1. Introduction.

In this article, we continue the research presented in [1–4]. The mathematical model Galiyev-Galiyev (MGG) is illustrated with new data. Specifically, sections 2–6 present experimental results, observations, and conclusions drawn from them. Section 7 presents theoretical models and space observations explaining the absence of dark matter and dark energy hypotheses in the MGG.

Almost 100 years ago, Einstein assumed that “Our experience hitherto justifies us in believing that nature is the realization of the simplest conceivable mathematical ideas.” In this paper, we follow this fundamental idea [1, page 391; 42].

No matter how powerful the human mind, or more specifically, its brain, may be, it will never be able to answer certain fundamental questions. This includes the problem of the origin of our Universe, namely, how that first impulse, a clot of energy or some field, arose, from which, as from a starting point, our Universe began to develop.

There are many theories of the origin of the Universe, which can be roughly divided into three groups: the first proposes that the Universe is unique and arose from a singularity or from some finite

volume; the second proposes that there may be many universes, and that the observable Universe arose from a pre-universe; the third proposes that the Universe arose from nothing [8–12].

Currently, the Big Bang (BB) model is considered the most popular and scientifically substantiated. However, the abundance of theories competing with the BB suggests that the BB model cannot be considered fully proven. Indeed, recent data from cosmological telescopes do not fully agree with some predictions of the BB model.

However, until now, the generally accepted understanding of cosmological processes has been based on the modern cosmological model (Lambda-CDM), which includes the BB, dark matter (DM), and dark energy (DE) as its most important components. Most modern Λ CDM analogs differ from it by the absence of one or another of these components. For example, the successfully developed Gupta model [12] does not use the assumption of DM. The authors of [1–7] have gone further. In book [1], they emphasize the absence in their model of the Universe not only of the BB, but also of DM and DE.

This article develops the MGG model intended to replace Λ CDM. In constructing the model, it was decided to proceed from the simplest and most general relations possible. The relation was used: $E^2 = p^2c^2 + m_0^2c^4$. This relation can be reduced to the Klein-Gordon-Fock equation. The last equation was used in [1–4], when considering both cosmological and quantum problems.

When considering the problem of the origin of the Universe, the assumption of the existence of a fundamental, parent universe was used. We will call it the pre-universe. Our Universe, a daughter universe relative to it, arose as a perturbation of this pre-universe. For simplicity, we will henceforth call this daughter universe the Universe.

The model of the origin of the Universe presented below is based on the above assumption. The model uses the nonlinear Klein-Gordon-Fock equation to describe the behavior of both the parent and daughter universes.

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From this, it follows that the proposed model differs fundamentally from the Big Bang (BB) model. It should be emphasized that the BB is the foundation of the modern Λ CDM (Lambda-Cold Dark Matter) cosmological model, where CDM stands for cold dark matter and Λ is the cosmological constant. The Λ CDM model describes a spatially flat universe expanding since the BB approximately 13.8 billion years. This model is based on Einstein's general theory of relativity and the cosmological principle (the homogeneity and isotropy of the universe on large scales). It was believed to successfully explain observations, including the expansion of the universe and large-scale structure formation. However, some observations of the Hubble Space Telescope and, especially, data from the James Webb Space Telescope (JWST) have cast doubt on the validity of the cosmological principle, the origin time of the universe, and the very idea of the BB.

Indeed, the very idea of the BB has two major flaws. The first is that it assumes the origin of the universe at a singularity. The singularity is unknowable. Thus, the generally accepted model, in principle, excludes the moment of the universe's origin from consideration. A second shortcoming is that it fundamentally fails to explain the so-called fine-tuning of the universe. That is, it fails to explain

the fact that the fundamental constants and initial conditions of our universe have strictly defined values necessary for the emergence of atoms, stars, galaxies, and, ultimately, life. Even small deviations from the early existed and present constants and conditions would lead to a completely different universe, or one devoid of biological life, raising questions about the causes of such fine-tuning.

Of course, modern cosmogony offers models free from these shortcomings [8–12]. First and foremost, these models assume the existence and emergence of many isolated worlds (universes) [8, 9]. In one of them might be implemented fine-tuning. Others assume certain evolutionary processes in Universe occurring in accordance with certain criteria [4, 8]. For example, we like the possibility of fine-tuning by optimizing energy losses through competition and synchronization of various wave, resonant processes occurring in the Universe [1].

The above questions were the initial initiating factors for our research. These questions are so deep and complex that they touch upon a wide variety of problems in fundamental physics. Furthermore, the cosmological data obtained in recent years by the JWST are so unexpected that they deserve a detailed discussion from various perspectives, in parallel with the most fundamental problems of physics. Here all elementary particles are considered to be wave-particles. Not all physicists agree with this approach. Many researchers view photons, gluons, and even electrons as points, that is, as dimensionless structures.

2. Basic Assumptions of the Model.

Here are the 9 main components of the MGG

1) There is a parent universe (pre-universe), filled with a scalar energy field (bosons). The pre-universe has a multidimensional space that ensures its stability. The bosons in the field have unimaginably high energies. The field is agitated by tiny quantum fluctuations. As a result of resonant interactions between the field and the fluctuations, the pre-universe gives all time birth to billions of "seeds" of rapidly evolving universes. Most of these are Planck-sized universes, which disappear immediately after their emergence. But there are also universes that exist for a time and evolve to large sizes. Some of them reach very large sizes before disappearing. One of them accidentally evolved into our Universe, which has the same fundamental parameters corresponding to fine-tuning.

2) The multidimensional "seed" (Universe) emitted by the pre-universe loses stability and disintegrates into an unimaginably dense unity of independent one-dimensional oscillating structures. This unity can be imagined as a conglomerate of oscillating strings. Each one-dimensional formation possesses virtually infinite energy and vibrates at its own frequency. The concepts of dynamics and distance arise. Time emerges. For one-dimensional structures, this dynamics is described in coordinate-time space. Each string had its own coordinates and time.

When bosons were ejected from the pre-universe, a separation of energy particles occurred, namely, all antibosons remained in the pre-universe.

Remark. This scheme was previously used by Stephen Hawking on the escape surface of a black hole (Hawking radiation). According to his theory, virtual particles, which consist from a particle and an antiparticle, emerges on the surface. The antiparticle falls into the hole, and the particle escapes from the black hole and exists as black hole radiation.

3) Strong nonlinearity causes each string oscillation to emit particle-waves (bosons). The strings themselves, when their oscillations reach critical amplitudes and complexity, can fragment into a vast multitude of their constituent bosons. As a result, regions beyond the initial one-dimensional structures become filled with a literally infinite number of diverse particle-waves. They begin to interact and create a new 3-dimensional space. A 3-dimensional condensate emerges, exhibiting a certain "macroscopic" behavior, but whose bosons occupy the same quantum state. The resulting condensate can be interpreted as the embryo (egg or superatom) of our Universe. This condensate is considered to be a kind of analogue of the photon Bose-Einstein condensate (BEC).

Remark. In what follows, where this does not lead to misunderstanding, we will often use the word "particle" instead of the words "particle-wave."

4) The density of the resulting condensate is very high and constantly increases due to the production of new bosons. Over an immeasurably small period of time, the condensate density reaches a critical level, at which the bosons begin to interact so strongly that they begin to transform into fermions [13–19]. Rapidly expanding zones of a new phase have emerged [15].

Fermions begin to form some dynamic structures. As a result, space and time become tightly coupled.

5) Richtmyer-Meshkov instability develops on the fronts of the resulting density waves. As a result, the condensate is filled with nonlinear, multivalued, enormous-amplitude waves that generate vortices. At the maxima of these waves and vortices, the fermionization process intensifies and becomes explosive. Exponential expansion of the condensate begins due to the incompatibility of the fermions.

6) At the same time, somewhat delayed relative to the onset of the expansion of the Universe, the density of the condensate begins to decrease. The fermionization process ceases.

7) The motion of particles in the resulting "soup" of diverse particles becomes chaotic and continually accelerates. Temperature arises. It rapidly increases. The initial condensate transforms into a high-temperature plasma consisting of quarks, gluons, and photons.

8) Gravity arises due to the rapidly accelerating motion of the plasma particles. It begins to counteract the rapid expansion of the Universe. The expansion of the Universe loses its exponential character.

9) The formation begins of embryonic structures of stars and galaxies. It is a result of the evolution of previously emerging multivalued, highly nonlinear waves having counter-rotating vortices (Fig. 9). According to this scheme, the Universe should contain an approximately equal number of counter-rotating spiral galaxies, and a huge number of structures in the Universe should rotate around some axis or rotate around some center [20–22].

3. Comments on the Assumptions.

We have presented several assumptions above, each of which attempts to capture some essence of unimaginably complex processes that occurred in a time unimaginably distant from the present. We will illustrate these hypotheses with data from experiments recently conducted under terrestrial conditions. An attempt at such a comparison may seem not fully scientific from a rational perspective. However, we do so, believing that a successful drawing accompanying the most complex phenomenon makes it perhaps not more understandable, but more relatable, as if bringing the researcher or reader closer to its understanding.

1)) We will illustrate hypothesis 1) with the drawings presented in Fig. 1. It shows (on the left) a

drop of water located on a vibrating flat surface. As the excitation frequency approaches the resonant frequency, active wave formation begins on the drop's surface. At resonance, active emission of tiny droplets from the spherical surface occurs. Instead of a drop, one can imagine a region filled with quantum particles (a bosonic liquid). This system is subject to quantum fluctuations. Random fluctuations can occur in such a way that the system enters resonance and begins to emit the "seeds" of universes, similar to that shown in Fig. 1 (left). Another drawing (on the right) is also included there. In it, the artist demonstrates his fantasy on the theme of the emission of daughter universes from a parent universe. In particular, he attempts to trace the process almost to galaxy formations!

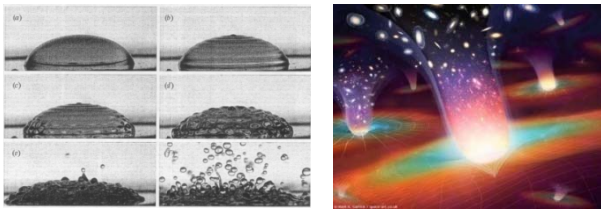


Fig. 1. Vertically excited waves and droplets on the surface of a 100 milliliter volume of water (left). Schematic diagram of the radiation of universes from potential wells of the pre-universe (right)

This possibility follows from the calculations presented in [1, 2]. They can be illustrated by processes occurring during surface cavitation. Fig. 2 shows that droplet detachment on the liquid surface can be accompanied by the formation of a bubble (rarefaction zone) deep within the liquid.

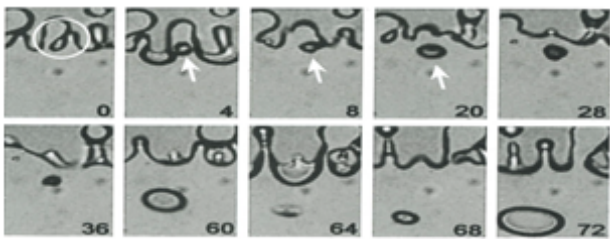


Fig. 2. Frames showing the entrapment of gas bubbles and the separation of droplets during surface cavitation [1, 2]

Both the formation of droplets and the formation of air bubbles occur simultaneously. This process of droplet separation may correspond to the emission of energetic "seeds" from the pre-universe. We assume that the "seed" contains bosons, while antibosons remain in the pre-universe. This will subsequently ensure the

emergence of matter, not antimatter in the Universe.

2)) Figs. 1 and 2 illustrate cases where a particle previously located on a two-dimensional surface finds itself in three-dimensional space. One can imagine an even more extreme case, where the temperature of this space is so high that the droplets instantly evaporate. Something similar is assumed in our model, where the emitted "seed" is instantly fragmented into tiny components. Specifically, the multidimensional space-time of the "seed" was fragmented into many one-dimensional elements. Moreover, according to the theory of "vanishing dimensions," the total energy of these elements increased greatly [23, 24]. According to this theory, systems with higher energies have fewer dimensions. The higher the energy, the lower the dimensionality of space-time.

The pre-universe could have had many dimensions. String theory states that space is stable if the number of its space dimensions can be 1, 3, 5, 10, or 25. The "seed" emitted by the pre-universe also had a high number of dimensions. Therefore, the volume of the original "seed" could have greatly increased after fragmentation. This process can be visualized by imagining a three-dimensional drop of oil hitting the surface of water. As a result of the impact, the oil droplet splits into many elements (particles), which spread across the two-dimensional surface of the water.

We assume that the original energy field of the pre-universe had many spatial dimensions. As soon as the "seed" left the pre-universe space, which is stable, it instantly disintegrated into a nearly infinite number of one-dimensional elements, independent of each other (Fig. 3).

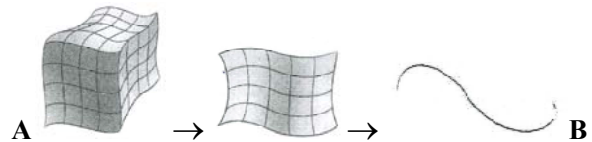


Fig. 3. Schematic diagram of the fragmentation of a multidimensional body (A) into one-dimensional strings (B) using a three-dimensional body as an example

The volume of the resulting conglomerate of one-dimensional strings depends on the dimensionality of the pre-universe and, depending on this dimensionality, can increase by many orders of magnitude compared to the original volume of the "seed" [1, 4].

3)) Fragmentation leads to the emergence of a conglomerate of unconnected one-dimensional strings, each of which represents a kind of independent one-dimensional universe. The strings possess enormous energy. After the impulsive decay of the "seed," it enters a state of highly nonlinear oscillations with various frequencies. In particular, just as on the surface of a liquid (see Fig. 1), folds appear on the strings, transforming them into two-dimensional and even three-dimensional structures (Fig. 4).

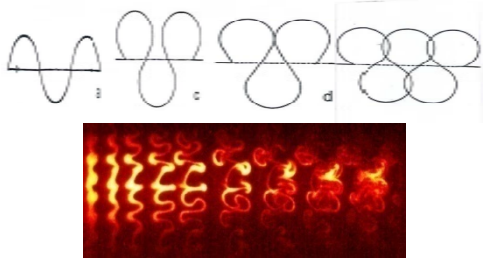


Fig. 4. Examples of the evolution of string-like elements into spatial structures [1, 2, 4]

As a result, the conglomerate of strings is transformed into a three-dimensional space. This process is accompanied by the emergence of particle-waves and "blocks" of bosons [1]. They arise both as a result of the separation of folds from the strings (Fig. 5) and due to the highly nonlinear interaction of the strings (Fig. 6, left).

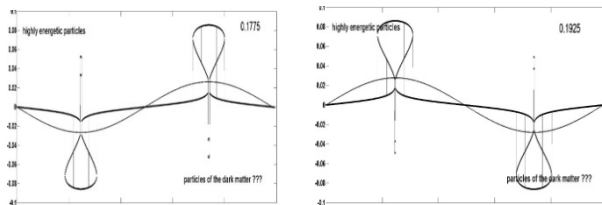


Fig. 5. Emission of particle-waves by bosonic strings during highly nonlinear, resonant oscillations

Other mechanisms for the generation of various particle-waves in the emerging three-dimensional space can also be proposed. An example of such mechanisms is shown in Fig. 6 (right) [25] and Fig. 7.

Thus, a huge number of diverse particle-waves arose, interacting with each other and creating a three-dimensional space. This four-dimensional condensate exhibits a certain "macroscopic" behavior, and its bosons occupy the same quantum state. The resulting condensate is, so to speak, the seed (superatom) of our Universe. Its temperature is not high. This condensate can also

be considered a kind of analogue of a photonic Bose-Einstein condensate (BEC).

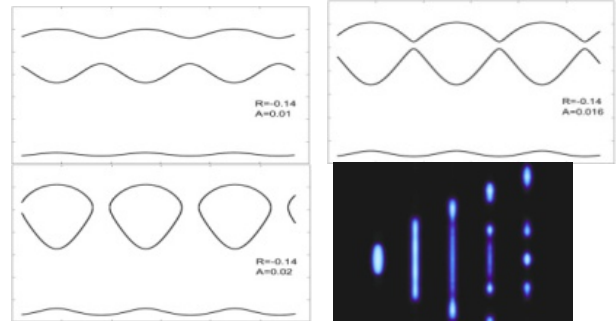


Fig. 6. Examples of formation of boson "blocks"

Of great interest is the possibility of the decay of the aforementioned cosmological strings into vortices, which can be considered the seeds of future quasars and galaxies. Here we present two examples of such fragmentation (Fig. 7).

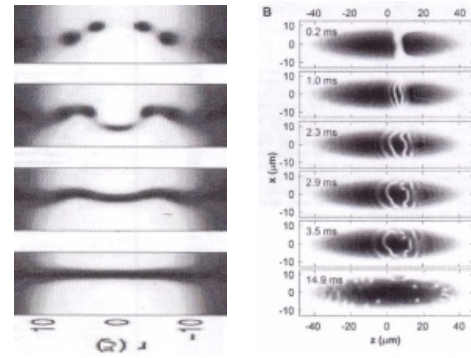


Fig. 7. Examples of the development of initial BEC density perturbations into vortices (right) [26, 27]

Examples of the evolution of BEC strings are given (Fig. 7). They are distorted into harmonics. Folds appear after this. They disintegrate into vortices (dots in Fig. 7). This is a resonant effect. We emphasize that light waves in BEC propagate very slowly [26–28]. Therefore, the speed of light can be close to the speed of sound in BEC. As a result, a certain resonance condition between sound and light is satisfied.

The possibility of such resonance is very important for us. In this case, the theory of resonant, multivalued waves developed in [1–4] immediately extends to the interaction of light and sound. But this may be important not only for our theory. We believe that this may be important for the origin of the Universe. While the speed of photons within the condensate may be close to zero, the speed of compression waves propagating there may be close

to the speed of light in a vacuum. All this prompts a new look at the very early evolution of the Universe. In particular, a condition existed for the resonant amplification of high-frequency perturbations of the density and their evolution into multivalued waves and vortices.

Remark. A photonic BEC is a quantum state in which many photons (bosons) occupy the lowest-energy state, forming a collective "superatom" of light. This phenomenon allows photons to condense into a single quantum state, demonstrating macroscopic quantum effects with light [29].

4) We constructed a diagram of the origin of space, linking it to the emergence of the energy field of strings, boson "blocks" and elementary particle-waves. In particular, we arrived at a state of the Universe in which it was like a photonic BEC. Now the question arises of how the BEC energy was transferred into the matter of the Universe. This is the field of quantum wave mechanics.

This is a very complex area of science, not fully understood even by the most highly skilled specialists. But it contains moments of surprising simplicity. For example, in quantum theory, all known fundamental particles are divided into two categories: fermions and bosons [13–15]. Fermions contain all matter particles (i.e., quarks and leptons) and are characterized by half-integer spin values, while bosons are the carriers of energy (force). These are gluons, w- and z-bosons, photons, and the Higgs bosons. They have spin values in integers, that is, 0 or 1.

Bosons and fermions behave differently. Theoretically, an unlimited number of bosons can coexist in the same location simultaneously. This is why, for example, lasers exist. Laser light exhibits photonic BEC, meaning that all particles—bosons (photons)—in the beam behave identically. In principle, the beam's energy is unlimited. In contrast, two fermions cannot coexist in the same location simultaneously due to the Pauli principle. In particular, two electrons can occupy the same atomic orbital only because they have opposite spins.

According to the above, particles possessing the properties of both fermions and bosons cannot exist. However, according to recent publications, this is not the case. Recently, particles have been discovered that behave like bosons (i.e., massless particles), when moving in one direction, and like fermions, when moving in the other. Such particles are called semi-Dirac fermions [16–19].

Of course, many aspects of the behavior of these particles still remain a mystery, and scientists

continue to study their properties in order to understand all the mechanisms underlying the observed phenomena.

The above demonstrates the complexity of the problem of describing the transition of energy into matter, despite the simplicity of Einstein's formula defining this process: $E^2 = p^2c^2 + m_0^2c^4$. This transition may be analogous to the Breit-Wheeler process, first formulated in 1934. According to it, a strong collision of two photons can generate matter [29]. Indeed, it can be assumed that during collisions, bosons influence each other so strongly that they transform into fermions.

In 2004, physicists showed [13] that if bosons are forced to move only along a single line, they acquire the properties of fermions. By forcing a gas of bosons to expand in one direction, scientists observed a change in the momentum distribution from bosonic to fermion [14, 15]. Let's illustrate this with Fig. 8. There, the dark circles correspond to fermions and the bright circles correspond to bosons. We hypothesized that very densely packed particles (bosons), under the influence of certain perturbations, can massively increase their density and acquire additional kinetic energy. As a result of the increased density and velocity, some bosons can begin to transform into fermions.

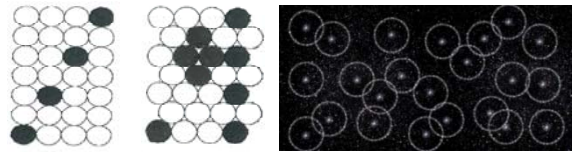


Fig. 8. Displacement of densely packed spheres can cause even stronger contact and increase their kinetic energy (left). Qualitative picture of the formation of fermion "bubbles," the generation of shock waves, and their interactions (right)

The figure on the left shows a situation where fermions have begun to emerge and then begin to interact with each other. However, two fermions cannot simultaneously be close to each other in the same quantum state (the Pauli exclusion principle). They repel each other. As a result the spread centres of new phase and shock waves around of them are were generated (right).

The transformation of fermions into bosons is also well known. As an example, consider the formation of Cooper pairs, when two fermions (spin 0.5) combine to form a system with spin 0 or 1. Another example is the fermionization of a one-dimensional boson gas [14].

According this scheme, the initial condensate of the Universe began to increase its expansion rate. This created zones of rarefaction.

As a result, the number of bosons acquiring sufficient kinetic energy to transform into fermions increased. The condensate begins to expand faster and faster. The process of matter formation (the conversion of energy into matter) began. This was the beginning of the emergence of our material Universe.

Rapidly expanding zones of the new phase emerged in the condensate. They might have resembled regions in a boiling liquid. The point is that while the boson density was below critical, perturbations in it, such as the emergence of individual fermions, did not change the situation. But when the boson packing density reached a certain critical value, the BEC "boiled" and began generating fermions in ever-increasing numbers. This resulted in rapidly growing "bubbles" of fermions.

General remark on 1))–4)). Each of the particles that emerged at the birth of the Universe possessed an energy that was difficult to imagine. Even in today's world, the energy of cosmic rays is off the charts. While the Large Hadron Collider can produce protons with 14 TeV, the OMGP particle (Oh-My-God particle) is 40 million times more energetic.

5)), 6)) The bubbles generate powerful hydrodynamic shock waves, vortices, and turbulent flows on a wide range of scales, from centimeters to those close to the size of the expanding Universe. Specific hydrodynamic instabilities develop on shock surfaces of density change, particularly the Richtmyer-Meshkov instability, which occurs when a shock wave interacts with a density jump in the medium. The interacts create multivalued waves and vortices (Fig. 9).

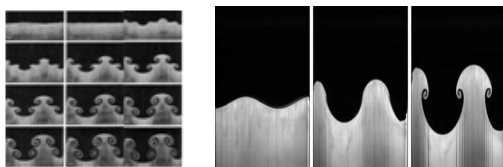


Fig. 9. Examples of highly nonlinear, multivalued waves arising at the interface between two fluids of different densities under an initial harmonic perturbation [1, 30]

It can be seen how, on the surface of a strong density jump in the liquid medium, the perturbations of very small amplitude begin to grow rapidly. As they grow, they dramatically change shape,

transforming into complex waves framed by vortices. The above-mentioned turbulent flows, multivalued waves, and vortices will soon become guides along which the very first quasars, stars, and galaxies of our Universe will begin to form.

The "boiling" provided a powerful impetus for the rapid acceleration of the expansion of the Universe, which had already begun during the formation of the initial superatom. To give at least some idea of the processes that arose during this time, we present Fig. 10.

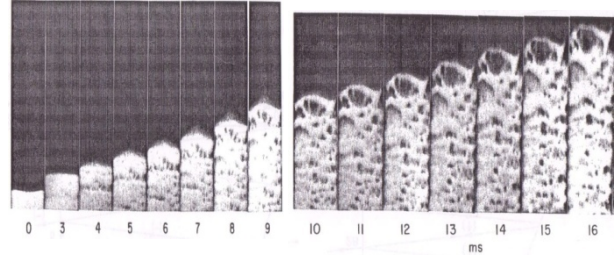


Fig. 10. Wave phenomena during a rapid pressure drop in a high-pressure pipe containing gas and granular material [2, 4]

The figure shows a high-pressure pipe. It contains a loosely bound, highly compressed material (glass beads). When the pipe opens, the material expands throughout its entire depth.

We believe that something similar occurred in the Universe, when the BEC density reached a critical value and the BEC "boiled" throughout its entire volume. However, somewhat later, the condensate density begins to decrease due to its expansion. Thus, the process of boson-fermion transition ceases as quickly as it began! The motion of diverse particles in the resulting "soup" becomes chaotic and continually accelerates. Temperature arises and rapidly increases. The initial condensate transforms into a high-temperature plasma consisting of quarks, gluons, and photons. We believe that gravity also arises with the motion of particles.

Let us remind that the boson (photon) condensate is a state of light in which photons behave like a boson gas, occupying a single energy state. Although the speed of light is constant in a vacuum, in the condensate of the universe under consideration, light traveled as "slow light." It is known that in the BEC, the speed of light can drop practically to zero, just as inside hot stars.

We assume that the condensate of the universe was encoded in precisely this state at the moment of its formation. Each boson in the BEC had nearly infinite energy. That is, the oscillation frequency of the scalar field in it was nearly infinite, while the velocity of the boson itself was

nearly zero. Subsequent transformation of the Universe during the first moments of its existence considered here, in our opinion, can be formulated, in a very rough approximation, as follows: conversion of the internal energy of bosons and their kinetic energy into mass and the energy of the resulting fermions. Thus, the initial energy of the bosons is converted into of the plasma consisting of quarks, gluons, and photons.

Remark. The process of fermionization corresponds, in our opinion, to the emergence of the strong interaction between particles. Thus, the "era" of strong interaction between quarks and gluons arose in the evolving cosmos. The "era" of the emergence of the strong interaction corresponds to the "era" of fermionization and the conversion of energy into matter.

7)), 8)) At some point, the temperature reaches a maximum and begins to decrease. The subsequent evolution of the Universe, in our opinion, largely corresponds to the standard model of hot cosmology (SMC).

However, there are also significant disagreements. According to the SMC, as revised approximately 20 years ago, regular galaxies formed through the merger of previously existing irregular (clumpy) galaxies, which took approximately a billion years to form. Regular galaxies arose approximately 5–6 billion years after the BB. These estimates have long been known and have been confirmed by results from the Hubble Space Telescope.

The situation with the SMC has become significantly more complex since the JWST and other recently launched space telescopes began operations. It should be emphasized that the JWST was created specifically to record light with very long wavelengths, namely those waves that propagate from the beginning of the Universe. According to these telescopes, well-developed galaxies already existed approximately 300 million years after the BB, and they already contained so-called "heavy" elements. Of course, these data are not definitive, but, in general, more and more data is accumulating that disagrees with the so-called "cosmological principle," which states that, on average, matter in the Universe is distributed uniformly throughout it. For this principle to hold, the size of the existing cosmic structure, must not exceed 1.2 billion light years. However, structures have now been discovered in space that exceed the requirements of the cosmological principle by up to 10 times.

9)) The situation with the Cosmic Microwave Background Radiation (CMB) is even more complex

[31–34]. We emphasize that, despite the explosive nature of fermionization, the number of bosons continues to exceed the number of fermions by many orders of magnitude. This relationship remains true to this day, as the fermionization process has never been repeated on such a scale throughout the Universe. The bulk of the bosons that existed then, in the form of photons, still exist today.

We believe these bosons form the CMB.

These radiation waves, which, according to the proposed model, initially had a huge amplitude and short wavelength. Then they were subsequently stretched to cosmological scales and to extremely small amplitudes due to the expansion of the Universe. It is important to note the enormous amount of time allocated by theorists for the formation of galaxies. But it is not enough. The fact is that the inhomogeneities of the CMB are so small, and at the same time, the gravitational interactions of particles of ordinary matter used in the analysis are so weak, that it was impossible to construct a satisfactory theory of the merging of ordinary matter into galaxies.

In the other hand, traditionally, it was believed that the CMB was one of the best confirmations of the BB. However, new measurements of the CMB have shown that this is not the case [31–35]. They have even more clearly demonstrated the existence of an "axis of evil" in the CMB [31] (Fig. 11). Perhaps the Universe is inherently asymmetrical. The cosmic microwave background radiation appears to move in a specific direction. This phenomenon is known as "dark flow" or "dipole anomaly."

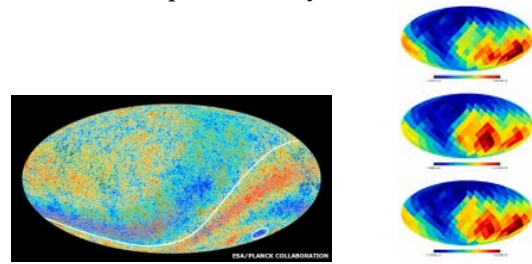


Fig. 11. From top to bottom: a 'cold spot' in CMB, NILC- σ map, SEVEM- σ map, and SMICA- σ map. Observe that the high intensity regions (red pixels), corresponding to the caps with the largest TT angular correlations, are almost the same in all three maps. Top down: a 'cold spot' in CMB, NILC- σ map, SEVEM- σ map, and SMICA- σ map. Note that the high intensity regions (red pixels) corresponding to the caps with the largest angular correlations are almost identical in all three maps

In particular, the strong discrepancy between the Hubble values obtained by astrophysicists and

more thorough studies of baryon acoustic oscillations do not support the BB hypothesis. To improve the agreement between recent cosmic data with the CMB, we propose that the CMB is incorrectly dated. According to our model of the Universe, it arose immediately at the time of the Universe's origin, and not 380.000 years later.

In addition, we also point out that the Universe contains many rotating objects, from tiny to unimaginably huge. One might expect that the directions of rotation and the planes in which these objects rotate should be random. But this is not the case! In particular, the JWST provides a previously unseen view of the Universe. It gave a detailed image of galaxies in deep space, providing an unprecedentedly detailed image of galaxies in the early Universe [21]. An analysis of spiral galaxies by their rotation direction in the JADES (Advanced Deep Extragalactic Survey) shows that the number of galaxies rotating in the opposite direction to the Milky Way is 50 percent higher than the number of galaxies rotating in the same direction relative to the Milky Way. This is hardly a coincidence. We attribute this to the "epoch" of the existence of multivalued waves that initiated the appearance of vortices of different scales (Fig. 9). Indeed, according to Fig. 9, one would expect the formation of two classes of oppositely directed vortices in space. Accordingly, one would expect that intergalactic filaments containing hundreds and thousands of galaxies also rotate, mainly in two opposite directions. Let us assume that the Universe may consist of two halves rotating in opposite directions. Perhaps this hypothesis explains the surprising asymmetry of the CMB (Fig. 11). After a detailed analysis, the authors of [33] concluded that the north-south asymmetry phenomenon is present with high statistical significance in the Planck CMB maps. This result confirms previous reports in the literature over the past 20 years, including the data presented in Fig. 11 (top of the figure 11).

4. Beginning of the Early Galaxies and the Hubble Tension.

1. Let us discuss the problem of multivalued waves and vortices again. According to the proposed theory, the formation of stellar and galactic early structures begins very early. This is a consequence of the fermionization process. When rapidly expanding zones of the new phase emerged, the Richtmyer-Meshkov instability developed at their fronts [1–4, 36, 37] (Fig. 9). As a result, the condensate was filled with nonlinear, multivalued,

and large-amplitude waves generating vortices. Specifically, folds arise on the moving wave surfaces. Each fold then evolves into a pair of counter-rotating plasma vortices (Fig. 12).

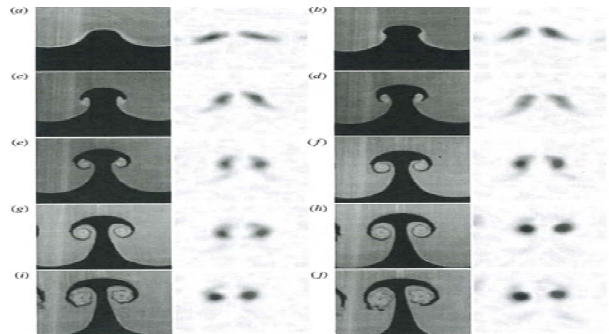


Fig. 12. The Richtmyer-Meshkov instability in shock tube experiments [37]

These vortices subsequently evolve into cosmic structures and galaxies. According to this model, the Universe should contain an approximately equal number of counter-rotating spiral galaxies and other objects. It also follows from this model that a huge number of structures in the Universe should rotate about some axis or rotate about some center [20–22].

Thus, the described model implies that multivalued waves and vortices, around which clusters of matter and galaxies can subsequently organize, arose at the very earliest moments of time [31–34]. The radiation from these clusters could have significantly influenced the CMB that was forming at that time.

New data from telescopes such as the James Webb Space Telescope (JWST) [33] show that massive galaxies formed much earlier and faster than previously thought. The energy of these galaxies, especially massive elliptical galaxies, is now considered a previously unaccounted source of CMB contamination. Researchers suggest that the radiation from early galaxies may account for between 1.4% and 100% of the total energy density of the CMB. Today, the CMB contains waves in the frequency range from 500 MHz to 500 GHz. Thus, it covers a vast range of frequencies, but, of course, only a small fraction of possible frequencies. It's possible that at other frequencies, the CMB's character is completely different from that shown in Fig. 11. It can be assumed that the cosmic microwave background (CMB) contains a significant contribution from very early galaxies and quasars [33].

The formation of early galaxies had its own unique characteristics. Many of them contain

virtually no cosmic gas, while in modern galaxies, cosmic gas can comprise up to 80% of the galaxy's mass. Apparently, the formation of some early galaxies was linked to the need to "feed" quasars at the centers of galaxies with cosmic gas.

2. From the above, it is clear how significant the difference is between the proposed model of the origin of the Universe and the Big Bang theory. Not only do the fundamental principles of these two theories differ, but also the chronology of events in the very early Universe. A change in the chronology of events can alter some fundamental quantities of cosmology, such as the Hubble constant (H_0). It characterizes the expansion rate of the Universe.

If H_0 is larger, the Universe is expanding faster and is younger. If H_0 is smaller, the Universe is expanding more slowly and is older. For example, if $H_0=67.4$ km/s/Mpc, then the age of the Universe is about $13.8 \cdot 10^9$ years. If $H_0=74$ km/s/Mpc, then the age of the Universe is about $12.6 \cdot 10^9$ years. Thus, the dynamics of H_0 are fundamentally important for understanding the Universe [38–40].

Among the most notable mysteries of recent decades is the so-called "Hubble tension." It is determined by the differences in the values of the Hubble constant (H_0): 74.0 ± 1.4 km/s/Mpc, measured using the local distance ladder; 71.6 ± 3.3 km/s/Mpc measured using so-called "time-delay cosmography" and 67.4 ± 0.5 km/s/Mpc obtained by analyzing cosmic microwave background (CMB) data. Thus, the Hubble tension may be greater than 8 km/s/Mpc.

It should be recalled here that the early Universe contained plasma in which highly nonlinear, multivalued waves propagated. These waves are very different from acoustic waves. However, the value of 67.4 ± 0.5 km/s/Mpc was obtained under the assumption that linear (acoustic) waves propagated in the plasma. In other words, the CMB was analyzed based on baryon acoustic oscillations, which did not exist in the early Universe.

We have already emphasized repeatedly that the waves propagating in the early Universe were highly nonlinear. Accordingly, their propagation velocity differed from the linear (acoustic) velocity. In the nonlinear case, the velocity depends on the wave amplitude.

Typically, the nonlinear propagation velocity is close to the velocity of linear disturbances.

Even in the case of strongly nonlinear waves, their velocity exceeds the velocity of linear waves

only by 10–15 percent. It was precisely such nonlinear waves that existed in the Universe during its early development. Therefore, we believe that then the wave velocity in the Universe exceeded the linear wave velocity used in calculating H_0 . This means that we must take this nonlinearity of wave propagation into account, rather than using the linear propagation velocity of baryon acoustic oscillations. This should lead to an increase in the calculated value of the Hubble constant (H_0). It is possible that the value of H_0 reaches at least 71.6 ± 3.3 km/s/Mpc instead of the currently used value of 67.4 ± 0.5 km/s/Mpc.

5. An Analogy for the Initial Evolution of the Universe.

Below, some experimental and calculated results are presented [38]. These results have no direct connection to cosmology. However, they can qualitatively illustrate the dynamics of the origin of vortices and the cosmic web in the Universe.

The evolution of perturbations of the interface between two media into multivalued waves, vortices (shown as dots), and turbulence was studied in [41]. The experimental results are shown in Fig. 13 (a, left). The data are presented for three time instants ($t = 100$ sec – top, 300 sec – middle, and 1700 sec – bottom). Fig. 13 (b, right) shows the results of the corresponding calculations. The figure demonstrates the highly nonlinear evolution of an initially smooth phase interface into multivalued waves. The interface then generates a chaotic mixture of the two media and vortices.

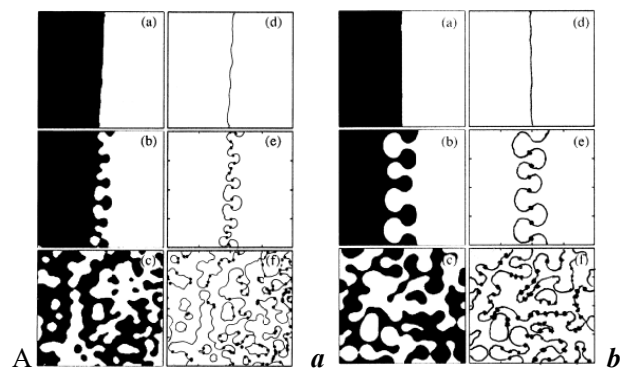


Fig. 13. Evolution of the initial perturbations of an interface into multivalued waves, vortices (shown by black dots), and turbulence. The indicated evolution during the Belousov-Zhabotinsky reaction (left). The indicated evolution according to the numerical solution of the Ginzburg-Landau equation (right)

Let us consider Fig. 13 in light of the above-proposed model of the origin of the Universe. We assume that figures (a) and (d) correspond to the initial state of the Universe immediately after the emergence of three-dimensional space, when the fermionization process has not yet begun. Figures (b) and (e) correspond to moments of fermionization, when multivalued waves and vortices arise on the shock surfaces created by rapidly expanding zones of the new phase. Curves (c) and (f) correspond to the chaotization of the primordial plasma, when multivalued waves are destroyed and a complex web of strings connecting the vortices emerges.

Remark. The noted analogy is not surprising. The calculations presented in section 3 were obtained based on the nonlinear Klein-Gordon-Fock equation, while those in Fig. 13 were obtained based on the nonlinear Ginzburg-Landau equation. We emphasize that the Ginzburg-Landau equation can be derived from the Klein-Gordon-Fock equation.

6. Discussion of the sections 1–5.

The Fine-Tuning Problem. The theory presented in this article is based on a huge number of hypotheses. We were unable to specify the parameters of many of them. Therefore, our study is purely qualitative, one might even say rough. We hope that, despite the crudeness and even erroneousness of the picture constructed here, its parts are sufficiently consistent and complementary.

Following Albert Einstein [42], we understand the emergence of the Universe as the beginning of a grand "symphony". During its introduction, more and more instruments begin to sound. In our case, these correspond to increasingly diverse physical fields. The Universe fills with sounds, like a vast hall, where each performer has its own instrument and a corresponding frequency, the beginning time, and, perhaps, the end of its mission. The sounds emitted by this instrument many time ago can still resonate throughout the Universe! More and more instruments come into play, but their sound must be consonant with the previously emerging melodies, without fundamentally altering them. Of course, all sounds are limited by some universal law. Apparently, they must necessarily sound, both in their origin and in their performance, in unison with one another. The orchestra should sound as energetically efficient as possible (the principle of energy economy during the evolution of the Universe). This principle is apparently realized when each instrument in the orchestra resonates

with itself and with the orchestra as a whole. Sounds that do not correspond to this principle either disappear over time or destroy the orchestra (the finish of the Universe evolution).

Each instrument's sound corresponds to a distinct physical field. The overlap of their sounds determines certain fine-tuning parameters of the Universe!?

These fields arise, exist, and disappear at different moments in time. They can differ greatly. Therefore, the Universe bears clear imprints of its existence at all moments in time (perhaps these imprints are reflected in the fine-tuning parameters!). For example, the first fields defining bosons existed in an extremely dense medium. But these were resonant scalar fields, with specific parameters existing at a specific time and spatial scale. With the further expansion of space, new fields emerged, for example, fields of force interactions or fermion fields. They arose under conditions of rapid change in both time and space. Their parameters and resonant frequencies could differ from each other by many orders of magnitude.

These parameters had to fit into the pre-existing sound of the entire Universe. It seems to me that such a description could not have been achieved without some kind of competition mechanism. According to Darwin's theory, any biological species, as it evolved, must resonate with "the orchestra of sounds" from the entire biological world of our planet, Earth.

Evolution and Resonances. Of course, the concept of resonance is very complex and can refer to various processes in physics, biology, or social life. For example, in physics, there is so-called resonant scattering, the physics of which is far removed from acoustic resonance!

The sequence 1)–9) introduced above can be viewed as a chain of evolutionary stages. At each of these stages, certain resonant conditions must be met. Only if they are met does the evolutionary process continue. One can imagine infinite billions of "seed" universes that have reached one or another stage of evolution from 1)–9) but that have not evolved further. They have not acquired the parameters satisfying the next resonant condition (bottleneck). Perhaps such a future awaits our Earth, when it reaches the next resonance (bottleneck) in its development without having the necessary parameters.

Remark. In the case considered in this article, the parameters of the emerging fermion field differ

greatly from the parameters of the boson field. However, it was precisely this relationship between the parameters of these fields that possibly corresponded to the conditions for the emergence of strong interaction particles. This resonant condition is a kind of "bottleneck" for the formation of quarks. The conditions for the formation of the next "bottleneck," allowing the formation of weak interaction particles, will not arise soon, but by the end of the first second of the Universe's existence. And only then resonant conditions will arise for the emergence of the first simple nuclei of matter.

The Randomness of the Universe. All of the above underscores the profound randomness of the origin and development of our Universe. In addition to its impossibly unlikely origins as a result of radiation from a pre-universe, it has, quite by chance but successfully, navigated an incredible number of other bottlenecks before reaching its current state.

Let us illustrate this with the example of Earth. At each stage, with each bottleneck, life on Earth, or at least the very existence of humanity, was greatly questioned. Generally speaking, only an infinite number of favorable chance events allowed human society to emerge on Earth, and any unfavorable event could have left Earth a lifeless lump of matter floating in the vastness of space.

It is quite possible that the future will not be so favorable for humanity. It can disappear as a result of a cosmic body impact on Earth or a massive series of nuclear explosions.

Multivalued Waves. The article explicitly links the initial development of the Universe with the formation of multivalued waves (MWs) within it. This is a significant point, largely determining the originality of the model. This is important because the main publications devoted to MWs appeared quite recently [1–4]. This is surprising, given that various linear and nonlinear waves have been studied for several centuries. We believe that the reason is that MWs arise almost exclusively in extremely high-energy processes or in processes that are poorly recorded by our measuring instruments. These include, of course, processes that occurred at the initial moments of the origin and evolution of the Universe. They occur in Universe and now in extremely high-energy processes, for example, during the merger of quasars.

On the other hand, MWs must exist at the quantum level. There, too, the energy concentration during dynamic processes can be quite high.

Under terrestrial conditions, MWs are observed where the appropriate measuring equipment is available. Of course, MWs realizations are quite rare, as they are usually unstable due to the action of gravity. As an example, we can cite coastal breaking waves. However, in the ocean depths, where the influence of gravity is less significant, we believe there are a huge number of long-propagating multivalued waves. In recent years, they have also begun to be recorded in solid bodies with a fairly complex, multilayered structure.

In the cosmology of the early Universe, the dominant view is that everything there was determined by the emergence and change of temperature. It's hard to disagree with this. At the same time, we suggest the possibility of a very strong influence of nonlinear wave multivalued processes on the evolution of the very early Universe. We even conducted a series of calculations linking the emergence of the strong and weak interactions with resonance phenomena that generate new solutions, the superposition of which describes multivalued waves. Strong and weak interactions manifest themselves at different frequencies, which prevailed at certain moments in the early Universe. This has even led to the introduction of the term "Multivalued Universe" (MU) [1]. Unfortunately, this direction of our research has not yet developed into results sufficient to present them in their final form.

The expansion of the Universe and DE.

The universe is not only filled with light; it is also filled with sound. In the early universe, these were nonlinear pressure waves. Among them, multivalued waves apparently existed. These waves propagated from the centers of the new phase (fermions). When the speed of these waves became much slower than the speed of light, they seemed to freeze (stop) in the form of giant bubbles (spheres) (Fig. 8, right).

These spheres formed the standard ruler of the Universe. We see this in the distribution of galaxies. Galaxies cluster according to the frozen pressure waves of the early Universe. By studying the structure of these galaxy clusters, we can attempt to determine the propagation speed of highly nonlinear waves in the early Universe. It should be emphasized that something similar has

recently been implemented to study the possible dynamics of so-called dark energy (DE). The Dark Energy Spectroscopic Instrument (DESI), using millions of galaxies and quasars, has constructed the largest three-dimensional map of our universe to date (Fig. 14 (right)).

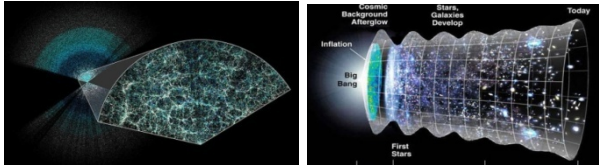


Fig. 14. The map of the Universe's expansion history released by the DESI (left). The Universe itself may be oscillating through billions of years of cosmic time [1] (right)

Combining DESI data with other experiments reveals signs that the influence of dark energy may be weakening over time, and that the standard model of the Universe may need to be updated [43, 44].

According to the standard cosmological model, the fate of the Universe depends on the balance between matter and DE: the fundamental ingredient that drives its accelerating expansion. The new DESI results are based on the largest three-dimensional map of our Universe. They trace the influence of DE over the past 11 billion years. The researchers see hints that DE, which many consider a "cosmological constant," may evolve over time in unexpected ways.

We believe these remarkable results can be interpreted without invoking the dark energy hypothesis. This is because [40, 41] used baryon acoustic oscillations (BAO) as a stellar instrument for measuring pressure waves. We propose that instead of BAO, a model of nonlinear, possibly multivalued, waves should be used. The impact of such a refinement can be significant. A comparison of linear and nonlinear spherical waves is shown in Fig. 15.

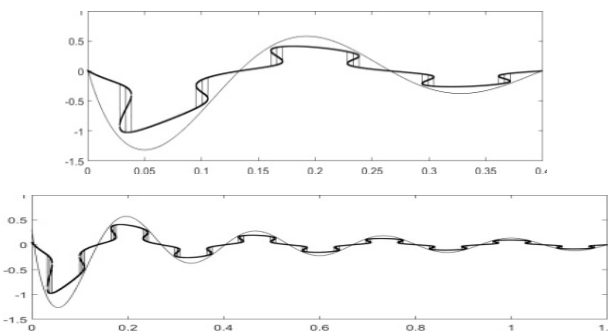


Fig. 15. Comparison of linear and nonlinear spherical waves [1]

The dynamics discovered in [43, 44] can also be explained not by the imbalance between matter and dark energy, but by something else.

At the very beginning, the sphere of bosons could be quite compact. Indeed, bosons can literally be stacked on top of each other. But at a certain moment, energy begins to transform into matter, that is, into fermions. Fermions repel each other. As a result, a colossal repulsion appears within the initial sphere, and the very rapid expansion of the Universe began. However, it may be oscillatory. In this, we agree with the findings of [43, 44].

Unexpected consequences of the dynamics of transitions from bosons to fermions and vice versa are possible. We have already said that we associate the explosive nature of the expansion of the sphere with the transition of bosons to fermions. When the number of fermions reaches a critical value, the reverse process apparently begins. Some fermions begin to transform back into bosons. It seems to us that this to some extent determines the oscillatory nature of the expansion of the Universe, which is shown in Fig. 14 (right).

All this may have determined the evolution of the Universe. The increase in the amount of matter and the simultaneous increase in the radius of the sphere led to a complex law of expansion of the early Universe. At the beginning of the expansion, it expanded very quickly, perhaps exponentially. Then the expansion slowed down greatly, and perhaps became oscillatory (Fig. 14 (right)). There is a delicate balance between the matter produced and the rate of expansion of the Universe. It possibly leads to oscillations in the evolution of the Universe. We proceed from the fact that an ideal sphere (the initial starting configuration of the Universe) is not a stable configuration, since it has a spectrum of natural oscillations. No matter how strong the connections between the particles of the medium are, the sphere can lose stability in one of the modes.

7. The Motion of Cosmic Objects as a Reason for the Introduction of the DE and DM Hypotheses.

Less than 100 years ago, when humanity first discovered galaxies, analysis of their motion suggested the existence of dark matter (DM). Seventy years later, when humanity began to construct the first maps of cosmic structure, it was discovered that the recession of very distant galaxies did not fit the then-existing standard

cosmological model (SCM). To expand the scope of this model, the hypothesis of dark energy (DE) was introduced.

Let us consider the basic tenets and reasons for the emergence of the DM and DE models before proceeding to the main material of this section of the article. Calculations have shown that the velocities of cosmic structures are so high that the observable Universe cannot be stable at such speeds. Therefore, the DM and DE hypotheses were introduced into cosmogony. They provide additional gravity binding moving structures together.

Let us focus on the regions in which DM and DE are assumed to be valid. According to all publications, the DM and DE hypotheses are unnecessary to explain the motion of the planets in the solar system. We assume it is because the velocities of these planets are small on cosmological scales. Some uncertainty exists only with the planet Mercury, and we will discuss this feature below. However, at the galactic level, DM is necessary, and it is usually needed not in the central regions of galaxies, but at their peripheries. There, the influence of DM can be very strong. The influence of DE on cosmic bodies is less clearly defined. It can only be said that DE does not effect on the motion of planets. However, on a cosmic scale, dark energy pushes galaxies apart, accelerating their recession. It is uniformly distributed throughout the Universe. This was believed until recently. Remarkably, it determines the overall pattern of the expansion of the Universe, meaning it begins to appear significantly only at velocities much greater than the velocities of planets and galaxies.

Thus, in our opinion, some connection can be traced between the velocities of the structures and DM and DE. The obvious benefits of introducing DM and DE are so compelling and numerous that the scientific community has embraced them remarkably quickly. The only problem is that the evidence for the existence of DM and DE remains only indirect.

All attempts to find DM and DE particles or their physical fields have so far been fruitless.

A situation typical of the development of science and the understanding of nature around us has arisen. As humanity discovers vast new areas of the previously unknown, it constructs a vast number of hypotheses to describe them. These hypotheses are not intended, first and foremost, to fully, accurately, and definitively describe the

previously unknown realm. Rather, they are intended to build a shaky bridge, allowing us to step into previously unknown territory.

About 100 years ago, humanity entered the realm of intergalactic distances and is striving to understand its structure. At the same time, it has practically only one method of cognition based on the analysis of information carried by light. Naturally, the more distant the radiation from space, the more often it brings mysterious information.

Another very important circumstance: the farther away a cosmic body or structure is from us, the higher its speed can be. We won't go into detail here, but we'll note that the speed of planets in the solar system reaches 50 km/sec. Many stars have speeds of about 200 km/sec; for example, the Sun is 230 km/sec. Taking into account the rotation of the galaxy and its movement through space, the total velocity of the Solar System relative to the CMB is roughly 368 km/s towards the constellation Hydra. Galaxies have speeds of about 600 km/sec. The speed of some galaxies can exceed 1000 km/sec. For example, the speed of galaxy MGC 1277 is 5066 km/sec. The speed of collision of galaxy clusters can be about 4000 km/sec. It's known that the speed at which galaxies recess from each other can be very high.

Studies of the motion of cosmic bodies and their distribution in space allow us to estimate the amount of visible matter in the Universe. At the same time, CMB allows us to calculate the total density of matter and energy. It turns out that the latter estimate significantly exceeds the former. According to these data, approximately 68% of the entire mass of the Universe is in the form of some kind of energy in its repulsive form.

All of this explains the difficulty of deep space exploration and, to some extent, the origins of DM and DE. We view these hypotheses as bridges that have allowed humanity to begin exploring new territories in deep and very deep space.

When these hypotheses were first proposed, it was assumed that the corresponding particles or fields would soon be discovered experimentally. But decades have passed, and to date, not a single experiment has definitively demonstrated the existence of DM and DE. This latter circumstance possibly explains the recent publications that do not use the DM and DE hypotheses when constructing a model of the Universe [1, 11, 12].

From the above, the following conclusions can be drawn:

1) It is a fact that DM and DE do not manifest themselves in any way in the solar system. What is the reason for this, and what is so remarkable about this system? Because the velocities of bodies in it are relatively low!

2) Newtonian mechanics works well within this system, but fails outside it, where the velocities of bodies are much greater than the velocities of the planets in the solar system. The equations of general relativity (GTR) also do not describe the motion of bodies in deep space if they have high velocities. This has led many to believe that DM and DE must be introduced to rectify the situation.

The issues discussed above will be addressed, to varying degrees, below.

7.1. The Effect of Velocity on Mass.

When considering the motion of the above-mentioned cosmic bodies, we will use the most general and at the same time extremely simple expression for the energy of a point mass [45]

$$E^2 = p^2c^2 + m_0^2c^4. \quad (1)$$

Here $p = mv$, E – is the energy, m – is the mass, v – is the velocity, c – is the speed of light, and m_0 – is the mass of a body at rest. From (1), it clearly follows that the mass of a body is somehow related to its velocity. This, of course, is nothing new.

$$m = m_0(1 - v^2/c^2)^{-0.5}. \quad (2)$$

Thus, we have a well-known example of an explicit and simple relationship between the mass, velocity of a point mass, and the speed of light. This relationship is well known in relativistic mechanics. Let us ask ourselves whether a similar relationship might exist for moving cosmic bodies.

An example of the dependence of the orbital velocity of stars and gas in a galaxy on the distance to its center is shown in Fig. 16. It is evident that the continuous curve contradicts of Keplerian dynamics and Newtonian mechanics.

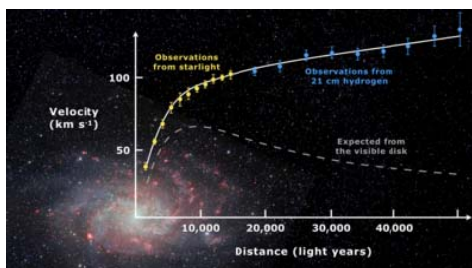


Fig. 16. Rotation curve of the spiral galaxy Messier 33 (yellow and blue dots with error bars) and the predicted distribution of visible matter (gray line). https://en.wikipedia.org/wiki/Galaxy_rotation_curve

If all the matter, all the mass, were concentrated in the central part of the galaxy, we would expect the curve shown by the dotted line. Of course, the discrepancy between the dotted and solid lines can be attributed to the fact that the gravitational mass, unlike in the Newtonian model, is not concentrated at the center of the galaxy. However, we will present a less obvious and more general explanation below.

Another problem is that near galaxy clusters, the trajectories of light particles are curved. As a result, these clusters act like lenses. This effect allows astronomers to "see" the invisible. From this effect, the distribution of the total gravitational mass of a cluster can be reconstructed. The mass of visible matter is insufficient to account for the observed strong curvature of light trajectories, providing direct evidence for the presence of a dark matter halo.

The distortion map shows the distribution of dark matter forming halos around clusters. It turns out that it is approximately five times greater than the mass of ordinary visible matter, which can be independently measured. And the extra mass is distributed throughout the cluster much more evenly than ordinary matter.

What is the reason for this? Let us assume that the velocities of celestial bodies are determined quite well. Indeed, an strong error in velocities is apparently excluded. Therefore, as many authors have assumed, problems with rotation curves for objects in space are related to errors in determining cosmic masses. It is traditionally assumed that additional masses (DM) and energy (DE) exist in space, invisible to our instruments.

In contrast, it has recently been proposed that rotation curves can be explained by the dependence of the mass of a cosmic object on its velocity [1, 46]. This dependence manifests itself at the velocities of objects existing in galaxies and their clusters. Naturally, at low speeds of planets, stars, and galaxies, the influence of their speed on mass, and especially energy, drops to almost zero.

The expression for mass presented in [46] has the form

$$m = m_0[1 + \mu(v/v_0)^n]. \quad (3)$$

Here μ , v_0 and n are constants adjusted to fit the observations. In particular, v_0 is the critical speed at which the influence of speed on the mass of a cosmic body begins to manifest itself. We write (3) assuming that $\mu = 1$ and $n = 2$, then

$$m = m_0(1 + v^2/v_0^2). \quad (4)$$

We take into account in (4) the effect of very high velocities comparable to the speed of light on mass. Here, we restrict ourselves to the case where $v^2 \ll c^2$.

Considering (2) and (4) together, we obtain an approximate formula

$$m = m_0 [1 + v^2 v_0^{-2} (1 - v^2 c^{-2})^{-0.5}]. \quad (5)$$

Expression (5) takes into account both the velocity of the cosmic object itself and the speed of light. It can be viewed as a certain generalization of (2) to the case of significant body velocities, when at the same time $v^2 \ll c^2$. Of course, the validity of using (5) requires research. Some steps in this direction will be made below.

Let's consider examples of the effect of velocity v on mass for the case $v^2 \ll c^2$.

Let $v \ll v_0$, then $m \approx m_0$. Let $v_0 \approx v$, then $m \approx 2m_0$.

Let $v_0 \ll v$. For the sake of example, we assumed that $7v_0 = v$. In the latter case $m \approx 8m_0$. From the examples, it follows that for object velocities much less than the speed of light, (4) can be used instead of (5). We will show below that (4) describes the effects in space for which DM was introduced.

Remark. According to quantum mechanics, particles interact with various physical fields as they move. The effects of this interaction are perceived by instruments as particle masses. We accept a similar assumption for cosmic bodies. In particular, the higher the velocity of a star in a galaxy, the stronger its interaction with the surrounding physical fields. This increases its mass and gravity. Thus, we arrive at the connection between gravity and velocity, which is revealed in the rotation curves (Fig. 16) and emphasized in [1].

7.2. The Effect of a Cosmic Object's Velocity on DE.

We have considered above a case that reduces to expression (5). Using this, we will examine the effect of the velocity of a cosmic body on energy. We will start from relation (1). We transform it using (5) to the following form:

$$(E/cm_0)^2 = [1 + v^2 v_0^{-2} (1 - v^2 c^{-2})^{-0.5}]^2 v^2 + c^2. \quad (6)$$

We further assume that $v^2 c^{-2} \ll 1$ and also that $2v^4 v_0^{-2} \ll c^2$. In this case, (5) yields

$$E^2 \approx (cm_0)^2 (v^6 v_0^{-4} + c^2). \quad (7)$$

This shows that, approximately, the energy depends only on the velocity of the object. For sufficiently low velocities, expression (7)

reduces to a special case following from (1). However, for sufficiently high velocities of cosmic structures, the term $v^6 v_0^{-4}$ can be equal to or even exceed the term c^2 .

It should be noted here that our analysis is essentially approximate, but we hope it is accurate enough for a qualitative analysis. It follows from this that, at velocities significantly less than 1000 km/sec, the effect of the structure's velocity on its energy is insignificant. At velocities close to 1000 km/sec, the effect of the term $v^6 v_0^{-4}$ becomes noticeable, and at velocities much greater than 1000 km/sec, the contribution of the cosmic structure's velocity to its energy can become very important. Then the energy of a moving system can exceed the energy of its stationary state by a factor of 5 or more, which is consistent with cosmic observations and eliminates the need to introduce dark energy!

1) Let's look at an example of this for the case where $v_0 = 400$ km/sec and $C = 3 \cdot 10^5$ km/sec. If v is 600 km/sec, then $(E/cm_0)^2 \approx 1.5 \cdot 10^6 + c^2$. If $v = 1000$ km/sec, then $(E/cm_0)^2 \approx 4 \cdot 10^7 + c^2$ and if $v = 3000$ km/sec, then $(E/cm_0)^2 \approx 16 \cdot 10^{10} + c^2$.

In the latter case, the contribution of the body's velocity in $(E/cm_0)^2$ is almost twice that of the contribution of the speed of light.

2) Let's look at an example of this for the case where $v_0 = 200$ km/sec. This is approximately the speed of many stars. Let $v = 600$ km/sec, then $(E/cm_0)^2 \approx 3 \cdot 10^7 + c^2$. Let $v = 1000$ km/sec, then $(E/cm_0)^2 \approx 6 \cdot 10^8 + c^2$. If $v = 3000$ km/sec, then $(E/cm_0)^2 \approx 3 \cdot 10^{11} + c^2$.

In the latter case, the contribution of the body's velocity in $(E/cm_0)^2$ is almost 10 times the contribution of light.

7.3. Refinement of Newton's Equations.

It is believed that DM constitutes approximately 85% of all matter in the Universe. DM typically accounts for between 10% and 70% of the mass of galaxies. Furthermore, "dark galaxies" have recently been discovered. These are objects that, according to [47], are more than 99% dark matter.

However, all efforts to detect particles or a physical field that clearly determine the properties of dark matter have been unsuccessful. The dark matter model is certainly very effective, but it has not been well-tested experimentally.

Therefore, alternative theories to dark matter have been proposed to explain the observations. The most successful of these is modified Newtonian dynamics (MOND), a theory that proposes a modification of Newton's laws to explain the observed properties of galaxies [48–50]. However, despite successful simulations, the MOND theory has recently encountered difficulties. There are also other theories in which the authors do not use dark matter to describe the motion of celestial bodies.

In this section, we consider a special case of the theory presented in Section 7.1. According to this theory, the mass of cosmic bodies depends on their velocity.

A strong decrease in the velocity of a cosmic object or the removal of galaxies far from the center dramatically changes the gravitational properties of the cosmic object. Specifically, its motion begins to conform to Newtonian theory, and the need to introduce dark matter in the calculations disappears. As an example, let's look at the Bullet Cluster (1E 0657-56), which consists of two colliding clusters of galaxies. Strictly speaking, the name "Bullet Cluster" refers to the smaller subcluster moving away from the larger one. It is at a comoving radial distance of 3.72 billion light-years [51–54].

The clusters collided at an enormous speed, approximately 3.000 km/sec. After the collision, the resulting heated gas, which makes up the bulk of the visible matter in the colliding clusters, remains at the collision site. The behavior of this part is perfectly described by the Newtonian model. Thus, it was enough for the clusters to lose velocity, and the need for DM disappeared.

This is a typical situation arising during collisions between galaxies and their clusters. Another typical situation arises during the impactless interaction of two galaxies. Consider the case where a larger galaxy, passing near a smaller galaxy, captures its outer stars. As a result, the behavior of the remaining part of the smaller galaxy begins to obey Newtonian mechanics.

Let's formulate the above mathematically. To do this, we must slightly modify the classical Newtonian equations using (3) and (5).

We rewrite Newton's second law taking into account (3) and (5) in the following form

$$F = m_0 a [1 + \mu (v / v_0)^n (1 - v^2 c^{-2})^{-0.5}]. \quad (8)$$

Here F is the force, a is its acceleration. If $v = 0$, then the given formula coincides with Newton's result written for a point mass.

Now let's turn to Newton's law of gravitation written for celestial bodies moving at high speeds. We will consider them as point masses with masses M_1 and M_2 at rest. Taking into account (8), we write the law as follows [46].

$$F_{12} = g m_1 m_2 / r^2, \\ m_1 = M_1 [1 + \mu_1 (v_1 / v_{10})^{n_1} (1 - v_1^2 c^{-2})^{-0.5}], \\ m_2 = M_2 [1 + \mu_2 (v_2 / v_{20})^{n_2} (1 - v_2^2 c^{-2})^{-0.5}]. \quad (9)$$

Here g is the adjustable constant, r the distance between the points, v_1, v_2 are the velocities of the corresponding celestial bodies. We denote the adjustable constants as μ_i, v_{i0} and $n_i, i = 1$ or 2 .

If $v = 0$ equations (8) and (9) transform into Newton's equations. Generally speaking, those equations are more valid for high-speed celestial bodies. Their speed is determined by many factors, in particular, rotations of bodies, the expansion of the Universe, the influence of numerous attractors existing in the Universe, and the mutual attraction of celestial objects. On the other hand, the adjusting constants in (8) and (9) may take into account shape, density, and structure of the objects.

Relations (8) and (9) are qualitative. Their purpose is to demonstrate the possibility of describing the dynamics of celestial bodies without relying on DM. The latter is important for this article, as the emergence of DM does not fit into the structure of the evolutionary stages of the very early Universe presented above.

Remark. At near-light speeds (relativistic velocities), classical Newtonian equations cease to apply, since the mass of a body ceases to be constant. The equations of special relativity are used. However, both approaches fail to model cosmological data explainable by DM. We explain these data by introducing equations (8) and (9) into scientific circulation in place of the dark matter hypothesis. At the same time, equations (8) and (9) establish a certain connection between Newtonian equations and Albert Einstein's special theory of relativity.

Of course, the applicability of equations (8) and (9) at relativistic speeds is not obvious and requires special research. We emphasize that the effects described by these equations in cosmogony are significantly averaged out, since bodies in this case are modeled as point masses.

7.4. Mercury's Orbit and Dark Matter.

Let's further consider the influence of the velocity of celestial objects in formulas (8) and (9).

In the mid-19th century, science was shocked when it was discovered that Newtonian mechanics did not accurately describe the motion of the planet Mercury. Only general relativity described its orbit more accurately. It can be assumed that equation (8) can also describe this orbit more accurately than Newtonian mechanics.

First, let's determine the velocity of Mercury. It is 47.9 km/sec. It is interesting to compare this velocity with the velocities of other planets: for Venus, it is 35.02 km/sec, for Earth, 29.78 km/sec, and for Neptune, 5.44 km/sec. It should be emphasized that only for Mercury does Newtonian mechanics require a correction. From this, we can conclude that for planets, the influence of their velocity begins to manifest itself when this velocity approaches 41.5 km/sec. Thus, equations (8) and (9) make sense to use, if the velocity of a celestial object significantly exceeds 41.5 km/sec. Of course, this estimate is very, very approximate. However, it correlates to some extent with data on galaxies. For example, Galactic ADC 252 DF2, where DM is not, has a velocity lying somewhere between 10 km/sec and 20 km/sec. The same velocity estimate is for the giant gas cluster formed during the collision of The Bullet Cluster (1E 0657-56).

Both of these cases, and the list could easily be expanded, there are the 41.5 km/sec criterion. Galaxies with velocities much higher than 41.5 km/sec must be calculated using formulas (8) and (9). Of course, these formulas are not set in stone. The motion and properties of cosmic objects are influenced by a huge number of parameters. There are cases where a galaxy moves at a velocity of approximately 1000 km/sec and yet its motion is described by Newtonian mechanics [54]. However, the obtained data allow us to make some estimates of the influence of velocity. To do this, we rewrite formula (8) as

$$F = m_0 a [1 + (v/400)^2]. \quad (10)$$

Here we have used fitting coefficients of $\mu = 1$, $n = 2$, $v^2 \ll c^2$ and $v_0 = 400$ km/sec. We emphasize that v_0 was chosen in accordance with the results obtained for planets. Now we will change the value of v in (10) according to the cosmic object under consideration. We emphasize that in equation (10), the value $(v/400)^2$ can also be interpreted as the mass of DM. In this case, the contribution of DM to the total mass of the planet Mercury would be approximately 0.01, since Mercury's velocity is approximately 47.9 km/sec. For planet Earth, the

contribution of DM would be approximately 0.005 of the normal mass. Thus, the influence of DM on the planets of the solar system could be very small. Apparently, this is why the possibility of DM formation did not discuss in the 19th century.

The situation with galaxies is completely different. When determining the speed at which cosmic objects move, scientists determine the reference point for velocities and their calculations. However, there are also some established, generally accepted values. In particular, many reference books give a velocity of 220 km/sec for the Milky Way galaxy. If we accept this value and follow formula (10), then the contribution of DM to the normal (visible) mass of this galaxy could be equal to 25%. Thus, according (1) we have $(v/400)^2 = 0.25$.

Now let's consider the local group of galaxies. According to some publications, a typical velocity of approximately 600 km/sec can be assigned to it. In this case, DM content within it could be approximately 2.5 times the normal mass. Our calculations show that $(v/400)^2 = 2.5$.

It is very difficult to assign a specific average velocity to the entire Universe. However, some authors believe it could lie somewhere around 1000 km/sec. In this case, there would be approximately 6.25 DM units per unit of normal matter. According to (10), we have that $(v/400)^2 = 6.25$.

Surprisingly, the given values of DM correspond to the modern cosmological model. Yet, they reject the existence of DM, arguing that the gravity of ordinary matter depends on its velocity.

How objects in the universe acquired this velocity is not specifically discussed here. Apparently, it is the result of the long evolution of the universe, during which its initial energy was partially converted into kinetic energy.

A final remark. The prevailing view is that the CMB is radiation generated at the moment of hydrogen atom formation. In our opinion, it is a trace of the photonic BEC that existed in the very first fractions of the first second of the Universe. Specifically, when there was little baryonic matter, that is, fermions, in the Universe. This is consistent with modern observations of luminous, baryonic matter in the modern Universe. In this case, the discrepancy between the baryonic matter abundance in the CMB and in the modern Universe disappears. If we accept all of the above, then the need for the DE and DM hypotheses used in Λ CDM largely disappears.

8. Conclusion.

At the beginning of the 20th century, Albert Einstein developed the general theory of relativity (GTR), which described the interactions of all bodies having mass and energy. It should be noted that GTR aroused great interest among cosmologists. Their observations showed that GTR described the results of astronomical observations better than all other theories. In particular, GTR was applied to describe the cosmos in two fundamental papers by Alexander Friedmann [55, 56].

These papers marked the beginning of a completely unexpected revolution in cosmology. According to one of Friedmann's results, the universe is not stationary and changes over time. Moreover, the universe could have expanded from some initial point. That is, there is a moment of the universe's origin, which could be perceived as its creation. However, Friedmann's articles went virtually unnoticed. Although their results were discussed by Einstein himself, who, generally, rejected the idea of a non-stationary universe. Even for him, it was unacceptable!

Although, as is well known, Friedman's theory is the first scheme of the BB theory underlying the Λ CDM model.

Of course, Friedmann's result could have been false, a mathematical lapse that does not reflect reality. Many researchers assumed so. But this theory strictly follows from GRT and, therefore, like general relativity, rests on the assumptions of the homogeneity and isotropy of the space-time continuum. When applied to the abstract space described in the works of the brilliant geometer Riemann and Einstein, these assumptions are quite acceptable, but as soon as they are applied to the real cosmos, everything becomes more complicated. Indeed, looking at our planet or, for example, the Milky Way galaxy, no one would say that space there is homogeneous and isotropic.

However, Friedmann accepted these assumptions when writing his articles, despite their obvious inconsistency with the observations of the time. For him was more imported that these assumptions opened up the fortunate possibility of integrating the equations of general relativity, in a very specific case.

The fallacy and unacceptability of Friedmann's assumptions were obvious. However, the temptation to integrate the equations of GRT was so great that these assumptions, with some reservations, are still used today. In particular,

Lemaître [57] did so. He obtained results like Friedmann. Thus, in a short time, the two researchers concluded that the Universe is non-stationary. Recall that at that time, most astronomers believed the Universe to be stationary.

The situation was resolved in the most unexpected way. Between 1927 and 1929, the astronomer Hubble demonstrated using the most modern equipment of the time, that the cosmos consists of numerous star clusters (galaxies) and that all galaxies are moving away from each other ("recession of the galaxies"). If this recession (expansion) is reversed in time, then, according to Hubble's results, the Universe would contract into a point. In other words, Hubble's observations confirmed the results of Friedmann and Lemaître, despite their use of hypotheses that clearly contradicted observations at the time. Hubble's result was so strong that it led astrophysicists to believe that on very large scales, much larger than the distances between galaxies, the Universe could be considered homogeneous and isotropic.

We described above the situation in cosmology almost 100 years ago. Since then, observational astronomy has developed enormously. Data accumulated that increasingly contradicted Friedmann and Lemaître's fundamental hypotheses about the homogeneity and isotropy of cosmic spacetime, while Hubble's results were refined. It should be noted that Hubble's data were also based on a number of assumptions. The most important of these is the assumption of the so-called "red shift" (using the Doppler effect to estimate the velocity of a cosmic object), and also, to a certain extent, assumptions about the cosmic expansion rate. In particular, it was assumed that the speed of light is constant throughout the Universe, that is, independent of the local density of the cosmic medium. It was discovered at the end of the last century that various methods for measuring the expansion rate of the Universe (i.e., the Hubble constant) yield values that differ from each other by approximately 10%. At the same time, information contradicting the assumptions about homogeneous and isotropic of the space continued to accumulate.

A situation has arisen that requires, at a minimum, changes of the assumptions about the cosmological space.

However, it is well known, that the scientific community, educated on the previous paradigm, cannot instantly discard it. This requires a generational change in the scientific community. A

single remarkable observation, one or even several outstanding articles, cannot instantly change the old knowledge (beliefs) on which previous generations were educated. Only the emergence and consolidation of very active proponents of the new paradigm can change the situation. Or an event similar to the explosion of the atomic bomb, which instantly introduced quantum mechanics into global culture, is needed.

The above shows that the situation in cosmology today is even more complex than it was 100 years ago. This is particularly true because there are now a huge number of highly qualified scientists capable of creating increasingly complex theoretical models of experimental data, including obviously erroneous experimental data. On the other hand, they are usually not deterred by the lack of experimental data that corresponds to their theoretical constructs.

This is where they differ from scientists of previous eras. At the beginning of the 20th century, a few experiments were enough to reject the idea of a luminiferous ether, which for over 100 years had successfully explained the wave nature of light propagation. Against this backdrop, it is striking how easily modern analogs of the luminiferous ether, namely dark matter and dark energy, are entering scientific circulation. They were introduced to explain certain, generally speaking, particular facts observed in the cosmos. But for many decades, despite the enormous efforts of numerous scientific teams, the existence of these "darknesses" has not been convincingly demonstrated by experiments.

The theory of the luminiferous ether was forgotten after the advent of the corresponding, widely known experiments and the special theory of relativity. Yet, many generations of scientists were raised on the ether theory.

Similarly, generations of scientists have now been educated on textbooks that model of the formation and development of the Universe on hypotheses such as inflation, dark matter, and dark energy. However, these hypotheses are nothing more than theoretical props of another, even more fundamental hypothesis—the Big Bang hypothesis.

A vicious circle has been created, with hypotheses being introduced to support other hypotheses. In the case of cosmology, it has recently been realized that to break this cycle, the situation must be studied as close as possible to the calculated BB moment. To this end, the JWST was launched into space in 2021. Its data were expected

to mark the end of cosmology, elevating the Big Bang hypothesis to the status of fully confirmed theories.

But this did not happen! The JWST data only complicated the issue. In light of the new data, the hypotheses about the Big Bang, inflation, dark matter, and dark energy have become even more questionable than before.

In this article, we continued to develop the rough scheme of the origin of the Universe that differs from the BB [1–4]. To support this scheme, we use data from experiments conducted under terrestrial conditions, as well as some observational cosmological data.

Final comments. Overall, the ideas developed in the article are based on the rejection of the Big Bang and the model of an initially very hot Universe. Based on this, the evolution of the Universe up to the formation of the quark-gluon plasma is considered. The subsequent evolution of the Universe is not largely considered. It is assumed that after the Universe evolves according to the modern cosmological model, which, however, lacks DM and DE.

The presented model in no way refutes the most important results of the Big Bang hypothesis. Namely, the expansion of the Universe discovered by Hubble in 1929, as well as the emergence and distribution in the Universe of light elements such as hydrogen, helium and a few others, as pointed out by Gamow in 1946 [58].

In the final conclusion, let us remember that the hardest thing to reject is something that doesn't exist, but to which humanity has become accustomed for millennia. This is confirmed not by Ptolemy's theory, which existed for over 1.500 years, but by the existence of religious beliefs.

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ПРОИСХОЖДЕНИЕ ВСЕЛЕННОЙ БЕЗ ТЕМНОЙ МАТЕРИИ И ТЕМНОЙ ЭНЕРГИИ

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Разработана модель происхождения Вселенной, ранее представленная в публикациях [1–7], основанная на существовании пред-вселенной. Модель не использует гипотезу Большого взрыва (БВ). Динамика Вселенной объясняется постоянным преобразованием ее энергии в массу и обратно, т.е. превращением бозонов в фермионы и наоборот. Возникновение пространства и времени также связано с превращением исходных бозонов в фермионы. Все это исключает существование темной энергии (ТЭ). Гравитация и масса тел связаны со скоростью их движения. Чем выше скорость, тем больше масса и сила тяжести тела. В результате необходимость в темной материи (ТМ) исключается. Модель также подразумевает, что микроволновое фоновое излучение возникло в первые мгновения Вселенной. Обсуждается проблема натяжения Хаббла.

В целом модель описывает трансформацию Вселенной из первоначального энергетического сгустка в материальные структуры, в частности, в многозначные волны, вихри и зачатки будущих галактик.

Ключевые слова: современная космологическая модель, проблема тонкой настройки, пред-вселенная, Вселенная, Большой взрыв, гипотеза, энергия, масса, частица-волны, бозоны, фермионы, многозначные волны, эволюция, галактики, натяжение Хаббла, скорость космических объектов, механика Ньютона, Многозначная Вселенная.