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The Theory of Local Expansion and Contraction of the Universe on the Basis of Dark Energy, Dark Matter and of Baryonic Matter

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Abstract: *The new model is based on the results of recent space experiments and the theory of local expansion and contraction of the Universe, which rejecting the theory a cyclic universe with a time-variable Hubble parameter and the "Big Bang" theory. The article provides comments on the model, proposed by the head of the Oxford Research Center, Dr. James Farns, in which it is assumed that dark energy and dark matter can be combined into one liquid with negative mass.*

Keywords: *dark energy; dark matter; quantum vacuum; superfluid ^{3}He-B; gravitation; antigravitation; spin; mass; dipole; polarization*

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1. Introduction

Today, are louder and louder voices are heard about the current crisis of theoretical physics and cosmology in particular. Martin Ries, the cosmologist and the astrophysicist, President of the Royal Society of London, believes that the birth of the Universe will remain a mystery to us forever. He declares: "We do not understand the laws of the universe. And never know how the universe appeared and what awaits it. The hypotheses about the Big Bang, which allegedly gave rise to the world around us, or that there may be many others in parallel with our Universe, or about the holographic nature of the world, will remain unproved assumptions". The purpose of this article is to show the role that a systematic physical approach to the study of the Universe can play in overcoming a crisis. To explain the physical nature of dark energy and dark matter and the accelerated expansion of the universe, Dr. James Farnes, the author of a new cosmological theory proposes to turn to Einstein's long-forgotten proposal: to recognize the existence gravitationally repulsive negative masses, which drive cosmic expansion and cannot coalesce into light-emitting structures [1]. Dr. James Farnes "have constructed a toy model which suggests that both dark phenomena can be unified into a single negative mass fluid. The model is a modified ΛCDM cosmology, and indicates that continuously-created negative masses can resemble the cosmological constant and can flatten the rotation curves of galaxies. The model leads to a cyclic universe with a time-variable Hubble parameter, potentially providing compatibility with the current tension that is emerging in cosmological measurements." [1]. Dr. James Farns's acceptance of the thesis of a cyclical closed universe returns cosmology to the past century. Our article proposes a new approach based on the model of local expansion and contraction of the open Universe, that deny the "Big Bang" theory and inflationary expansion. This model that allows to realize a balance in the Universe, to combine dark matter and dark energy into a single superfluid medium (analogue ^{3}He-B) and explain the mechanism of generation of dark matter and baryonic matter in strong gravitational and magnetic fields of galaxies.

2. The Model of Local Expansion and Contraction of the Universe

The standard cosmological model ΛCDM (Λ-Cold Dark Matter) is based on the ideas of Einstein's General Theory of Relativity (GTR) regarding the interpretation of the cosmological constant in the spirit of the concept of an anti-gravity medium with constant density. Unfortunately, being in the framework of the standard cosmological model ΛCDM, it is impossible to approach physically to explain the accelerated expansion of the Universe. Brian Schmidt winner of the Nobel Prize 2011 admit what "the cosmological acceleration remains as mysterious as in 1998… It will be necessary to wait for the theoretical insights that interpret anew the standard cosmological model, possibly with the

help of information obtained from a completely unexpected source"[2]. Such information may be suggested by a new cosmological model in which dark energy and dark matter are presented as two phases of a superfluid non-barion medium. Phase states characterizing dark energy and dark matter are considered in the model as analogous to two phases in ^{3}He-B: the superconducting α-phase and the spontaneously ferromagnetic β-phase [3]. The fundamental difference between them is that dark matter attracts, possesses gravity, while dark energy is in a certain sense inherent in antigravity.

2.1. The Mechanism of Generation of Dark Matter and Baryonic Matter

Dark matter is born in contact with the vortexes of dark energy in the strong magnetic and gravitational fields of galaxies. Several possible mechanisms for generating dark matter and baryon asymmetry have been proposed in the literature, leading to the equality of the energy density (mass) of baryons and particles of dark matter ($\rho_{b,o} \sim \rho_{dm,o}$), however, no natural explanation of this. In the article I propose a "natural" mechanism for the generation of dark matter and baryonic matter on the basis of deep analogies with the behavior of a superfluid medium ^{3}He-B. Magnetic resonance experiments showed that in the case of superfluid ^{3}He-B has an effect of Einstein - de Haas: this rotation liquid volume during magnetization. Since the magnetization of the atoms ^{3}He does signify their spin polarization, then the Einstein-de Haas effect is the rotation of the volume of the liquid at $dS/dt \neq 0$ where S is the total spin of the extracted volume of the liquid. It can be assumed that many polarization physical phenomena in baryonic matter and dark energy must have the same nature and proceed identically. The formation of significant masses in the vortices of dark energy, much larger than the mass of the medium, explains the mechanism of the phase transition of dark energy into dark matter. Dark matter gathers into bunches, is attracted to galaxies and forms halos around them, which extend to several galactic radii. These halos predict the observed dark matter distribution in galaxies and are derived from observations using modern radio telescopes. According to the energy interaction of the components, cold and hot dark matter is distinguished. Currently 2019, the Space Telescope of the European Space Agency Gaia monitors the active stellar flow S1, moving at a speed of 310 m/s, relative to the solar system. The author of the study, Pierre Sakivi, suggests identifying wimps, candidates for the role of the main component of cold dark matter and a new interaction force (fifth force), which sets in motion the stellar flows. Analysis of experimental data associated with the investigation of the anisotropy of physical space allows us to assume the existence of a fifth interaction (of fifth force) [4]. Most galaxies rotate so fast that they should break apart, but the invisible "halo" of dark matter should hold them together. Thus, dark matter can be considered as an analogue of the spontaneously ferromagnetic β-phase of the superfluid ^{3}He-B. The author of the local theory of the expansion of the Universe, a professor at Moscow State University A. Chernin, argues that in intergalactic space, where there is no gravity mass and magnetic field of large cosmic formations (galaxies) acting on dark energy, neither dark matter nor baryonic matter exists, but one dark energy [5]. The paper A.Chernin calculated "the value of the radius around the local group (R_{ZG}) =1.4Mpk. The local group this gravitationally bound quasi-stationary system with a total mass M=(2-3)x10^{12} Mʘ" [5].

This mass constitute the "normal" (baryonic) matter of stars and interstellar medium, and dark matter, which is about five times more. If we assume that the volume of space occupied by dark matter in a local group is also five times larger than the volume of a conventional baryonic substance, then the energy density (mass) of baryons and particles of dark matter will be comparable ($\rho_{b,o} \sim \rho_{dm,o}$).

The equation of gravity $G_{\mu\nu} = 8\pi G T_{\mu\nu}$, obtained by Einstein within the framework of the general theory of relativity, relates the curvature of the space $G_{\mu\nu}$ to the energy-momentum tensor $T_{\mu\nu}$ and the Newtonian gravitational constant G, due to the spatial inhomogeneity of the Universe as a whole relate to its individual parts. From the analysis of this equation given by Friedman, a completely natural consequence will emerge that the behavior of individual areas of the Universe will differ depending on their density: in areas with a substance density higher than the critical one, it will shrink until collapse, and in areas with low density - expand, which corresponds to observational astronomy data. Consequently, it is not the stationarity of the Universe as a whole that should be understood not as the expansion or contraction of its borders (which does not exist), but as the inconstancy of parameters in its local areas. In this case, the claims of the "Big Bang" theory and impose to the Universe as a whole a scenario of inflationary behavior that contradicts the laws of physics will have no reasonable grounds.

2.2. Antigravity Mechanism the Dark Energy

Phase state characterizing dark energy, are considered in the model as analogous the superconducting α-phase ^{3}He-B. Consider the antigravity mechanism inherent in the dark energy. Similarly to the interaction of vortices in superfluid ^{3}He-B, vortices in the environment of dark energy should also interact. In ^{3}He-B, magnetization of vortex cores takes place along the axis of the vortex, that is, there is a spin polarization of the superfluid liquid. Thus, the space environment in the turbulent region can be characterized by the state of "all-round stretching"[3]. In the framework of the hydrodynamic model, the effect of a superfluid fluid on the vortex core can be mathematically described by the introduction of pressure P at the boundary of the vortex core. The sign of pressure depends on the nature of the internal stresses in the medium. If these the internal stresses in the dark energy have the character of "all-round stretching", then the pressure will be negative. That is all the dynamic characteristics will have a sign opposite to that which they would have had for the usual ideal incompressible fluid with the same kinematic properties [6]. This behavior of the system is similar to the presence of a negative mass. Strength Fp - a repulsive force acting in the space environment (dark energy):

$$Fp = - \int s' Pnds, \quad (1)$$

where n - waterproof external normal to the surface S '

ds - an infinitesimal element of the surface

has the effect of anti-gravitation and may cause the accelerated expansion of the universe[3]. In addition, the instability of the quantum vacuum (dark energy and dark matter) in external fields is a purely quantum phenomenon. In quantum electrodynamics (QED), this phenomenon is characterized by the production of electron - positron pairs in a physical vacuum (dark energy and dark matter) with a nonzero rest mass [7]. This allows us to consider the density of the dark energy as positive. Thus, the model proposed above (analogous the superconducting α-phase ^{3}He-B) corresponds to the properties of dark energy as a macroscopic medium [5] :

1)its density is positive, and the pressure is negative and equal to the energy density in absolute value;

2) it does not create gravitation, but anti-gravity, since its effective gravitating density is negative.

Einstein's antigravitation obeys the linear dependence of the force on the distance:

$$F_e = (c^2/3)\, \Lambda R , \quad (2)$$

where Λ is the Einstein's cosmological constant.

The dark energy density ρv is expressed in terms of cosmological Λ and gravitational G constants:

$$\rho_v = c^2\Lambda /(8\pi G) \qquad \Lambda = (8\pi G\rho_v)/c^2 \quad (3)$$

Substituting in the formula (3) a known density $\rho_v = (0.721 \pm 0.025) \cdot 10^{-32}$ kg / m³ and

$G = 6.672 \cdot 10^{-11}$ N • m ² / kg² find cosmological constant Λ:

$$\text{The absolute value of } \Lambda\ (c^2) = 1.17 \cdot 10^{-41} \text{ N / (kg • m)} \quad (4)$$

The cosmological constant Λ in equation (2) describes the elastic properties of the medium, and the formula itself (2) in accordance with Hooke's law describes the repulsive forces between the structural elements forming a dark energy. For a homogeneous isotropic the dark energy the generalized vector Lame wave equation is valid. This equation is equivalent to two simpler wave equations, which describe elastic waves of two types: longitudinal waves that propagate with phase velocity Vp and transverse waves with phase velocity Vs. It can be gravitational, electromagnetic and torsion waves. The speed of propagation of longitudinal waves is higher than the transverse. Gravitational waves can be attributed to the longitudinal waves, since according to the calculations of Laplace, their speed should exceed the transverse electromagnetic waves at least 7 000000 times [8]. In 1994, when the July 16, 1994 great nucleus of the comet Shoemaker-Levy collided with Jupiter gas sphere, radial oscillations gave rise to the surface gravity waves, instantly resulted in fluctuations in several geodetic satellite command-measuring complex of Russia. Speed, formed by the collision of a comet with Jupiter, gravitational waves significantly exceeded the velocity of electromagnetic waves (light spreads from Jupiter to Earth is about 1 hour).

2.3. Physical Substantiation is Given of the Term used in the Model of Scientists at Oxford University "The Tensor of Creation", which Allows Regulating the Creation of Negative and Positive Masses in the Universe

Einstein's General Relativity theory is not capable of explaining the irreversible processes of the production in the Universe of dark energy and baryonic particles. I.R. Prigogine, winner of the Nobel Prize wondered: "Is the Universe a closed system in terms of thermodynamics?" Answering to this question, I. Prigogine came to the conclusion that the postulate of the absence of heat exchange between the environment and the volume element (the adiabatic process of cosmological evolution dQ = 0) is erroneous [9]. Einstein's universe is a closed universe with constant entropy since in such a universe there are no irreversible processes. For a description of the birth of matter in Einstein's general relativity is necessary to be considered variations in the density of matter due to the production of particles. This leads to disruption in time symmetry. Prigogine proposed to add the number of variables included in the standard model (the pressure P, the mass-energy density σ and the radius of the universe R (t)) an additional variable n - the density of the particles and an additional equation, which would tie the Hubble function of radius of the universe R (t) and the birth of particles n. In the case of the universe, consisting of particles of the same type of mass M, when the mass-energy density is simply equal to σ, and the pressure P - vanishes, Prigogine offers a simple equation that takes into account the creation of particles:

$$\alpha H^2 = \frac{1}{R^2}\frac{\partial nR^3}{\partial t} \tag{5}$$

where α - kinetic constant equal to zero or positive.

In this equation (5), the value of α and H are positive since we are talking only about the birth (and not destruction) of the particles. In Minkowski's space, where H = 0, the production of particles cannot be (equation $H\psi = 0$ equation is often called the Wheeler – DeWitt Equation). Furthermore, in Einstein's Universe the total number nR^3 constant irrespective H values, α = 0 [9]. Considering how the birth of the particles leads to a modification of Einstein's equations of GTR in terms of the first and second laws of thermodynamics, we have an entropy production proportional to the rate of particle production [9].

2.4. The Advantage of the Open Universe Hypothesis over the Thesis of a Cyclical Closed Universe

Finally, Dr. James Farns's acceptance of the thesis of a cyclical closed universe returns cosmology to the past century [1]. Exactly the proposal of Einstein and Bergman to improve the Kaluza theory, to close on yourself the fifth dimension and to represent the world cyclic, closed or compactified by the fifth coordinate leads to the wrong law of decreasing gravitational forces in the five-dimensional world [10]. The author of the evolutionary paradigm of the Universe, the laureate of the Nobel Prize I.R. Prigogine established that "isolated, closed systems evolve to chaos, and open systems evolve to ever higher forms of complexity." [9]. According to the second law of thermodynamics, external forces weaken in the system, and a closed system tends to a final equilibrium state and "thermal death". The experience of developing complex open systems is described by the Fibonacci method, from which it follows that new structures and internal driving forces arise in an open system. Thus, closing the fifth coordinate of Einstein dooms the Universe to degradation. But if we allow the fifth coordinate to be singled out (in particular, the metrics are independent of the fifth coordinate), then the same 5-dimensional solutions of the Einstein equations yield a different solution, resulting in $F_r \sim 1/r^2$ which is confirmed experimentally [11].

3. CONCLUSION

Thus, in our proposed cosmological model, a systematic approach is implemented, which makes it possible to explain the evolution of the Universe by the anisotropic distribution of dark energy, dark matter and baryonic matter in space. At the same time are indicated the so-called "System-forming" links, due to which the system as a whole acquires new properties that are absent in any part of it. A good example is the transformation of dark energy into dark matter and into baryonic matter in strong gravitational and electromagnetic fields. The approaches in the models are different, and the conclusion is the same: the Universe is a dynamic system that continuously generates positive and negative masses of matter and regulates their density by expanding its boundaries. This circumstance leads to new, more general conservation laws inherent in the physics of open systems.

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