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Anisotropy of the late Universe

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ABSTRACT

The standard cosmological model ΛCDM (Λ- Cold Dark Matter), on the basis of Einstein's general theory of relativity with its postulate that the Universe was "isotropic," turned out to be erroneous. The article presents the latest research, indicating that the expansion rate of the Universe varies from region to region on a large spatial scale. Moreover, the anisotropy of non-stationary processes in the solar system relative to fixed microwave radiation is due to the action of three mutually orthogonal forces directed respectively to the center of the Galaxy, to the top of the sun and the axis of rotation of the sun. The first two movements of the Sun are caused by the forces of gravity and inertia, which form the orbit of the Sun when it rotates around the center of the galaxy. The third direction is associated with the rotation of the Sun around its own axis and the translational motion due to a new type of interaction — the fifth force.

Key words: background radiation–apex–anisotropy–fifth force–dark energy–dark matter–quantum vacuum–superfluid ^{3}He-B–gravitation–antigravitation.

1 INTRODUCTION

The isotropy of the late Universe is an assumption greatly used in astronomy. However, many studies have recently reported deviations from isotropy with a definitive conclusion yet to be made. New, independent methods to robustly test the cosmic isotropy are of crucial importance. According to the media outlet, study lead Konstantinos Migkas, of the University of Bonn noted that equations based on Einstein's general theory of relativity suggest that the universe, which has been expanding continuously for more than 13.8 billion years, was growing at roughly the same pace "on large spatial scales". As the researcher pointed out, since the Observations of the cosmic microwave background – "leftover relic radiation from the Big Bang" – show that it appears to be isotropic, "cosmologists extrapolate this property of the very early universe to our current epoch, nearly 14 billion years later." And this statement is a mistake. It appears that the expansion rate of our universe may vary from place to place, which may force scientists to reassess some of their assumptions regarding the universe's nature, space.com reports citing a new study that was conducted using data from NASA's Chandra X-ray Observatory and ESA's XMM-Newton. Migkas and his colleagues have examined some 842 galaxy clusters during the course of their study, and established that the expansion rate of our universe appeared to differ from region to region. "We managed to pinpoint a region that seems to expand slower than the rest of the universe, and one that seems to expand faster!", Migkas noted. "Interestingly, our results agree with several previous studies that used other methods, with the difference that we identified this 'anisotropy' in the sky with a much higher confidence and using objects covering the whole sky more uniformly." In article "Probing cosmic isotropy with a new X-ray galaxy cluster sample through the LX−T scaling relation" K. Migkas, G. Schellenberger, T. H. Reiprich, F. Pacaud, M. E. Ramos-Ceja, L. Lovisari (Submitted on 7 Apr 2020) authors write: "In this work, we investigate the directional behavior of the X-ray luminosity-temperature (LX−T) relation of galaxy clusters. A tight correlation exists between the luminosity and temperature of the X-ray-emitting intracluster medium. While the measured luminosity depends on the underlying cosmology, the temperature can be determined without any cosmological assumptions. By exploiting this property one can effectively test the isotropy of cosmological parameters over the full extragalactic sky. Here, we used 313 homogeneously selected X-ray galaxy clusters from the MCXC catalog and obtained core-excised temperatures for all of them. We find that the behavior of the LX−T relation heavily depends on the direction of the sky. Strong anisotropies are detected at a $\sim 4\sigma$ level toward (l,b)∼(280∘,−20∘). Several X-ray and

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cluster-related effects that could potentially explain these anisotropies were examined, but none did so. Interestingly, two other available cluster samples appear to have a similar behavior throughout the sky, while being fully independent of each other and our sample. Performing a joint analysis of the three samples, the final anisotropy is further intensified ($\sim 5\sigma$), toward (l,b)$\sim$(303∘,−27∘), which is in good agreement with other cosmological probes. This result demonstrates that X-ray galaxy cluster studies that assume perfect isotropy can produce strongly biased results whether the underlying reason is cosmological or related to X-rays. The identification of the exact nature of these anisotropies is therefore crucial" [1] . In an earlier the article "Fundamental experiments on the detection of the anisotropy of physical space and their possible interpretation" 2015 Yu.A. Baurov, Yu.G. Sobolev, F. Meneguzzo presented a new interpretation of the global anisotropy of physical space of the Universe. [2] . It is radically different from that in the standard cosmological model ΛCDM (Λ- Cold Dark Matter), the inflationary theory of anisotropy. Yu.Baurov expose the space anisotropy cosmological vector potential - a new force of nature,generated by the interaction of elementary particles of matter, which he called "byuonami.". Among experiments confirming the anisotropy of physical space, known experiment posed by nature. This is the work of NASA, carried out in 1989 - 1992 years. using spacecraft Cosmic Background Explorer (COBE) to detect the anisotropy of the thermal background radiation, discovered in 1965. A. Penzias and Robert Wilson [3] .

2 EXPERIMENTS CONFIRMING THE ANISOTROPY OF PHYSICAL SPACE IN THE SOLAR SYSTEM

The anisotropy of the background radiation (called relict background radiation) arises from the motion of the solar system with respect to this radiation, which refutes the cosmological principle that the universe is in generally homogeneous and isotropic. The consequent movement of the anisotropy of the background radiation in the microwave range 10 GHz - 33Ggts characterized by a temperature difference in two diametrically opposite directions:

$\Delta T \approx To\ [1 + (v/c) \cos \Theta]$ (1)

where Θ - the angle between the line of sight and the velocity vector of the observer relative to the background radiation of the universe. [4]

On Earth, this kind of anisotropy is manifested in the form of the dipole component of the 24-hour, while the speed of the "absolute" motion of the earth is ~ 10^{-3} speed of light.

According to experiments conducted in 1976. aboard NASA's flying laboratory B.Kori, D.Uilkinsonom, D.Smit and other results are as follows: speed of the Earth relative to the background radiation of the universe is V = 320 - 390 km / s., and the velocity vector is in the direction of the galactic coordinate system with coordinates: : L ≈ 194º, B ≈ +65º. Later measurements of the anisotropy of the background radiation in relation to the solar system were made in 1977 a group of researchers from Berkeley (D.Smit, M.Gorenstein and R.Myuller). In the experiments, NASA, held in 1989-1992, Using spacecraft Cosmic Background Explorer (COBE) anisotropy of the background radiation was finally established not only in relation to the solar system, but also in relation to our galaxy and throughout the universe. [3]

Currently, the most reliable results are the following.

For the solar system:

V = 390 ± 60km / s

The galactic coordinate system heliocentric velocity vector is directed to the point with coordinates:

L = 247º ± 23º, B = + 56º ± 13º

(The ecliptic: λ≈164º, ϕ≈ - 1º)

The point with these coordinates is called the absolute apex of the solar system, or just the apex of the sun. This Apex according to the materials of the symposium "Cosmology: Theory and observations", Moscow, 1978. located in the constellation Leo.

For our Galaxy:

Vg≈ 600 km / s

The vector speed of our galaxy relative to the background of the universe is directed to the point with coordinates:

Lg ≈ 260º, Bg ≈ + 32º

This point can be called APEX Galaxy (located in the constellation Hercules).

Article A.A. Efimov, and A.A. Shpitalnaya "Note on the Solar System motion in relation to microwave radiation of the Universe" [4] indicates that the Solar System motion in reference to the microwave radiation can be detected through an analysis of various phenomena in Solar System. It turns out that many transient phenomena (earthquakes, solar flares, etc.) occur with a certain asymmetry, which is given a definite direction in space. A.A. Efimov in coll. "Development of methods of astronomical research," Series "Problems of Research of the Universe" could offer a method of identifying the direction of maximum anisotropy for a large number of short-term non-stationary processes in the solar system at any fixed spherical coordinate system, if the spherical coordinates of these processes are known. [5]

Processing coordinate non-stationary processes (solar flares various points, the total number of flares $\geq$ 2 earthquakes with M $\geq$ 7) as described in A.A. Efimov has shown that these processes, despite the different nature, its distribution is given in the "stationary" space a certain direction. Moreover, the processing in the same manner perihelion origin of comets with parabolic orbit also indicates the presence of "stationary" solar space preferred direction, in good agreement with the directionreceived by solar flares and earthquakes. It should be noted that the obtained results after machining completely reliable. For example for 3324 outbreaks statistical evaluation of the significance of the result is 8σ, where σ - standard random variable. The anisotropy in the direction of the apex to the sun reflected in the symmetry breaking flare activity with respect to a plane perpendicular to the direction of Apex. Due to the relative motion of the background material of the universe there is some anisotropy in the structure of our galaxy and other galaxies in the structures of flying at speeds of several hundred kilometers per second relative to its apex background radiation.

In the 21st century, analyzing the anisotropy of the thermal background radiation of the universe, it was found that in addition to the forces of gravity and inertia in the cosmos operates more longitudinal force causes the movement of our solar system to the point of "Apex of the Sun", located in the constellation of Leo [4] or Hercules [2] . Availability scalar magnetic field generates force on the charge in the direction of its velocity which is greatly differs from the known Lorentz force [6] . Based on the fact of the real existence of bias currents (jb) in the physical environment around a moving charge jb = 1/4π ∂E / ∂t, employee of Tomsk Politechnical University Gennady Nikolaev established a functional relationship of these currents and induced them magnetic field:

H⊥ = 1/c 2jb|| / ro = 1/c ev/r^2 sinφ,

H|| = 1/c 2jb⊥ / xo = 1/c ev/r^2 cosφ, (2)

where: jb|| = $\int$s$_0$ jb|| dS,

jb⊥ = $\int$sσ jb⊥ dS, (3)

(jb = j || + jb⊥)

The surface S_0 restrict axial flow of the bias current jb ||. On its outer surface is determined by the intensity of the magnetic field vector H⊥. Surface Sσ restricts radial flux bias current jb⊥. On its outer surface is defined by the inner strength of the magnetic field H|| [6] . Considering that on the surface of the Sun is concentrated electric charge Q≈1,7 • $10^{2\circ}$Kl. and the outer sphere flowing currents, creating a magnetic field H≈80α / m (stained H≈ $10^5\alpha$ / m), you can imagine the magnitude of the longitudinal forces, forces to move the sun along with the planets of the solar system to its apex at a speed of 330km / s. [2] . The result of the new longitudinal force is a collision of galaxies. This process is accompanied by the absorption of smaller galaxies, large galaxies and the formation of powerful gravitational waves. Instead of fading gravitational waves left in the universe after the mythical "Big Bang", the scientists found quite noticeable gravitational waves, born in the collision of galaxies and black holes.

3 DARK MATTER IS ANISOTROPIC GALACTIC MEDIUM

Dark energy and dark matter form an anisotropic galactic and intergalactic medium, which account for 95% of the average density of matter in the Universe and, being distributed extremely unevenly in the Universe, together with baryonic matter provides processes of local expansion and contraction of the Universe [7] . 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 [7] . The fundamental difference between them is that dark matter attracts, possesses gravity, while dark energy is in a certain sense inherent in antigravity. I suggest in the theory of local expansion and contraction of the Universe on the basis of dark energy, dark matter and of baryonic matter abandoning the theory a cyclic universe with a time-variable Hubble parameter. The dark matter is born in contact with the vortexes of dark energy in the strong magnetic and gravitational fields [7] . Also it found that in the case of superfluid ^{3}He-B has an effect of Einstein - de Haas: this rotation liquid volume during magnetization. Since atom magnetization ^{3}He means and their spin polarization, the effect of Einstein - de Haas - a volume of liquid during the rotation dS / dt, where S is the total spin fluid volume selected. A similar effect should be observed, and in contact with the dipole vortex of dark energy in the magnetic field of the galaxy. Emerging large domains have sufficient weight to gravitation and are the building blocks that make up dark matter. In intergalactic space, where the disturbing factor of the masses of large space structures is absent, and there is no dark matter. RZG is the radius of zero gravity (outer space, where the force of gravity and repulsion are equal). When R <RZG predominant attraction, with R> RZG - repulsion. The paper A.Chernin [8] calculated the value of the radius around the local group RZG - gravitationally bound quasi-stationary system with a total mass M = (2 - 3) x 10^{12} Mθ. This mass constitute the "normal" (baryonic) matter of stars and interstellar medium, and dark matter, which is about five times more. The value RZG = 1,3-1,4Mpk. [8]. In the space defined by the radius RZG, the physical cause of formation of structures of dark matter (gravitating medium) may be similar to the one that causes the formation of stars from interstellar substances - Jeans gravitational instability. J. Jeans (1902) first showed that the initially homogeneous gravitating medium with the density ρ_0, is unstable with respect to small perturbations of density. If the environment has arisen condensation, the gravitational force will seek to increase it, and the elastic force will seek to expand the impact and return it to its original state. Under the influence of these opposing forces, the medium will either vibrated or will undergo repetitive motion. The nature of the motion depends on the relationship between the wavelength of the disturbance and some critical scale, called the Jeans scale:

LJ = cs [π /(Gρ_0)]$^{\frac{1}{2}}$ (4)

This value depends on environmental parameters: velocity of acoustic vibrations in a medium (the speed of the longitudinal wave) cs and density ρ_0.

It defines the minimum scale perturbations, from which the elastic force of the medium are not able to withstand the forces of gravity, and that it leads to the gravitational instability of the medium [9] . In this small-size random packing medium grow in time if they cover an area of linear size L> LJ. Perturbations with scales smaller than the Jeans length L <LJ, are acoustic vibrations.

Several possible mechanisms for generating dark matter and baryon asymmetry have been proposed in the literature, which allow us to compare the energy density (mass) of baryons and dark matter particles (ρb, $_0$ ~ ρdm, $_0$), however, no natural explanation of this fact. An international group of astronomers under the general direction of Sylvia Garbari of the University of Zurich (Switzerland) in 2019 conducted a simulation of various possibilities for the distribution of dark matter in the vicinity of the Sun. It turned out that even in the most moderate variant; its amount is comparable with the amount of baryon (ordinary) matter. New data on the dynamics of the 2,000 orange dwarfs of the spectral class K closest to our star were used to determine the density of dark matter in the vicinity of the Solar System. As a result, it turned out that the density of such matter in the vicinity of the Sun is 0.022 solar masses per cubic parsec, or 0.85 GeV/cm^3 ~12×10^{-25} g/cm^3. In this case, the density of baryonic matter in the same area is estimated by the authors at 0.098 solar masses per cubic parsec, or 3.8 GeV/cm^3 ~50×10^{-25} g/cm^3. Dark energy is distributed more evenly throughout the Universe, and its density is measured with an accuracy of a few percent $\rho = (0.721 \pm 0.025)10^{-29}$ g/cm^3 [8].

The equation of gravity $G\mu\nu = 8\pi GT\mu\nu$, 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.

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) [2] . 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. Clarification of the nature of dark matter will help solve the hidden mass problem, which, in particular, consists of the anomalously high rotation speed of the outer regions of galaxies. Of particular interest to astronomers was the Andromeda nebula, in which the speed of stars around its center does not decrease, as celestial mechanics predicts, is inversely proportional to the distance to the center R, but remains almost constant (Figure 1). This may mean that the galaxy along its entire length contains a significant mass of invisible matter ("galactic halo"). Moreover, the approach of the Andromeda galaxy and our Milky Way galaxy, observed with the help of radio telescopes, can be explained by the existence of the fifth fundamental interaction between dark matter and baryonic matter.

Figure 1. The beautiful galaxy of Andromeda.

According to the energy interaction of the components, cold and hot dark matter is released. By cold dark matter, we mean particles that move with nonrelativistic velocities. Physicists have several such candidate particles at their disposal. It can be an axion - a particle with an extremely small mass and very weak interaction or more exotic variants. For example, if there is a compact additional space, then its vibrations will be perceived by us as some very massive particles (Figure 2). Hot dark matter - these are particles that move at speeds close to the speed of light. Their mass is so small that they remain relativistic even at a low temperature of the Universe, starting with several hundred degrees Kelvin. As calculations show, the mass of such particles should be less than 100 eV. This means that they are at least 5,000 times lighter than an electron. A suitable candidate for this role is neutrinos.

4 DARK ENERGY IS AN INTERGALACTIC ENVIRONMENT THAT PROVIDES LOCAL EXPANSION OF THE UNIVERSE.

Dark energy in cosmology is a hypothetical form of energy introduced into the mathematical model of the Universe in order to explain its accelerated expansion. In the standard cosmological model, dark energy is a cosmological constant - a constant energy density that uniformly fills the space of the Universe (in other words, non-zero energy and vacuum pressure are postulated). The rate of expansion of the universe is described by the cosmological equation of state. The resolution of the equation of state for dark energy is one of the most urgent tasks of modern observational cosmology. Astronomical observations made by a group of researchers using the Hubble Space Telescope-HST in 1998 made it possible to establish accelerated cosmological runaway of galaxies (expansion of the Universe). In 2011, American scientists won the Nobel Prize in Physics for discovering the acceleration of the expansion of the universe. However, the question arises: if the Universe expands, then where does the energy come from to maintain a constant the cosmological density of energy? Academician V.Rubakov writes about this: “There is no law of conservation of energy in cosmology. The universe expands, but energy thickness is constant. Volume increases and the energy in that volume increases, too. Where does it come from? From nowhere, there is no law of conservation of energy” [10] . Here is an inexhaustible source of energy a quantum vacuum. Antigravitation cosmological theory of general relativity Einstein described by a linear force versus distance:

$F = (c^2 / 3) \Lambda R$, (5)

where Λ - the cosmological constant.

The interpretation of the cosmological constant in a spirit of understanding of the antigravitating environment with a constant density was the basis for the standard cosmological model ΛCDM (Λ- Cold Dark Matter).

The model ΛCDM dark energy is taken as an invisible space environment, physical nature and microscopic structure of which is unknown. However, it is assumed that the dark energy as a macroscopic medium has a number of special, peculiar only to her properties:

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

2) it does not create the attraction and antigravitation [8]
.

Presumably, as a result of these special properties of dark energy in the observable universe repulsive force exceeds the force of gravity. This conclusion was made on the basis of astronomical observations carried out by a team of researchers from the Habble Space Telescope (HST). They established an accelerated cosmological recession of galaxies. 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. Future experiments will test more accurately consent flat ΛCDM - models with observational data. It is possible that there is disagreement, rejecting the cosmological constant, as the cause of accelerated expansion, and theoretically it will be necessary to explain this fundamental result. 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”. [11] . In this paper, based on the development of the theory of superfluid media are invited to expand the scope of the standard model and give a physical explanation of the cosmological acceleration, based on the structural features and the elastic properties of the space environment. 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” [12] . 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 [13] . 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):

$Fp = - \int s' \, Pn \, ds$, (6)

where n - external normal to the surface S ’ ds - an infinitesimal element of the surface has the effect of antigravitation and may cause the accelerated expansion of the universe [13] . 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 [14] . 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 [8] :

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.

5 CONCLUSION

The Universe is a dynamic system that continuously generates baryonic masses of matter and dark 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. Cosmologists extrapolate isotropic property of the very early universe to our current epoch, nearly 14 billion years later and this statement is a mistake. The isotropy of the late Universe is an assumption greatly used in astronomy. However, many studies have recently reported deviations from isotropy [1,2,3]. New, independent methods to robustly test the cosmic isotropy are of crucial importance. It appears that the expansion rate of our universe may vary from place to place, depending on the density of dark energy and dark matter in various areas of the Universe and the presence of a new fundamental interaction (fifth force).

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