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Dark Matter and Baryonic Matter

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Abstract: *The paper suggests a possible mechanism for generating dark matter and baryonic matter, which leads to the equality of the energy density (mass) of baryons and particles of dark matter ρ (B,0) ~ ρ (DM, 0), on the basis of the expansion of the Standard Cosmological Model ΛCDM (Λ-Cold Dark Matter). The article presents the physical experiments on the detection of dark matter in the near-Earth environment and the production of electron-positron pairs in dark matter under the action of cosmic radiation and relativistic protons according to the data of the detector AMS-02, placed on the ISS and the research of plasmoids in of the Military Space Academy named after are considered A.F. Mozhaisky with the help of satellites.*

Keywords: *physical vacuum; electron; positron; proton; mass; energy; resonance*

1. INTRODUCTION

The sciences of the laws of behavior of matter under extreme conditions and of cosmophysics are closely related and intertwined. The universe is the source of fundamental information. Unlike laboratory experiments, in astrophysical objects the time of existence of extreme states varies from milliseconds to billions of years, which allows for their detailed observation and measurement with the help of space probes, orbital and terrestrial telescopes in a different wavelength range. In this comparison of cosmic observations with the results of laboratory studies demonstrates profound analogies, evidencing, at a minimum, the unity of the physical principles of the behavior of matter in a wide range of densities (approximately 42 orders) and temperatures (10^{13}K). This is information on the hydrodynamic mixing of highly emitting relativistic and magnetized flows and jets, solitons, etc. Academician V.E. Fortov notes: "With increasing energy density (p and T), the substance acquires an ever more universal structure, the properties of matter are simplified. The growth of pressure and temperature destroys molecular complexes, form atomic states, which then lose external electrons responsible for the chemical identity of the substance, due to the ionization temperature and / or pressure ionization "[1]. Unfortunately, being within the standard cosmological model of ΛCDM, it is not possible to approach dialectically to the development of the universe as a whole, including the galactic and intergalactic medium, which accounts for 95% of the average density of matter in the universe. As a result of Planck's astronomical telescope Universe is composed of:

- Dark energy (68.3%);

- Dark matter (26.8%);

- "Ordinary" (baryonic) matter (4.9%) [2].

According to Professor A.D. Chernin - "dark energy is an invisible space environment, the physical nature and microscopic structure of which is unknown" [3]. However, dark energy as a macroscopic medium has a number of special properties inherent only to it:

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.

The author of the local theory of the Universe expansion A.D. Chernin finds his niche in the global cosmological theory of A. Einstein. He writes: "The phenomenon of cosmic antigravitation is well described by the general relativity of A. Einstein" [3].

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

$$FE = (c^2 / 3)\,\Lambda R, \quad (1)$$

where Λ is the Einstein's cosmological constant.

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

$$\rho v = c^2\Lambda /(8\pi G) \quad (2)$$

The cosmological density of dark energy is now measured to within a few percent [3]. Interpretation of the cosmological constant in the spirit of the notion of an antigravity medium with constant density was used as the basis for the standard cosmological model of ΛCDM. In [4], on the basis of the development of the theory of superfluid media, it is proposed to expand the framework of the standard model and give a physical explanation of the cosmological constant, based on the structural features and elastic properties of the dark energy. Dark matter behaves very differently. Academician V.A. Rubakov states: "These are the usual particles in the gravitational plane, they gather in clots, and then attract ordinary matter to form galaxies. Of course, new particles neutral with respect to electromagnetic interactions, so they do not shine and do not absorb light "[5]. 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 (ρ (B,0) ~ ρ (DM, 0),), however, no natural explanation non was found [6]. In my 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 and by the production of electron-positron pairs from a physical vacuum in quantum electrodynamics (QED).

2. Experiments

At the beginning of the 21st century, works began to appear in which a model of a physical vacuum possessing the properties of a superfluid liquid consisting of pairs of electrically dissimilar charged particles-fermions with zero total spin of the pair. Such a model described the dielectric properties of a vacuum and the creation in it of pairs of electrically dissimilar charged

particles (electron-positron pairs) [7]. Further development of the theory of superfluid media allowed us to consider phase transitions in physical vacuum models, analogous to phase transitions in superfluid 3He-B [8]. L.Boldyreva, in her model of the superfluid physical vacuum (SFW), significantly expanded the analogies between the properties of superfluid ^{3}He-B and the cosmic medium (dark energy), mainly due to the inclusion of the properties of vortices: spin and electric polarization of the medium in vortices, inertia properties vortices and superfluid spin currents between them [9]. Experiments on magnetic resonance made it possible to establish that in the case of superfluid ^{3} He-B, the Einstein-de Haas effect takes place: this is the rotation of the volume of the liquid upon 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, 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. Consider the Einstein-de Haas experiment, in which the rotation of a ferromagnet placed in a constant magnetic field is demonstrated. The traditional mechanics of continuous media, postulating the symmetric stress tensor, is applicable only to processes without an internal distribution of moments, when the moments equations are fulfilled identically. At the same time, in the polarization medium, under the action of a magnetic field, internal moments can arise, that create tangential stresses with an asymmetric tensor. This effect is explained in that the spins of ferromagnets initially oriented arbitrarily under the action of a magnetic field acquire a predominant orientation in the direction of the field. If in the initial state, the total angular momentum of all the spins is zero, then in a magnetic field it acquires a definite value. By the angular momentum theorem, this will lead to a rotation of the crystal lattice in the opposite direction to the spins. In addition, the internal torque of the spins causes a tangential stress, leading to torsional deformation of the ferromagnet. Fluctuations were first localized in a small part of the system, and then spread and led to a new macroscopic state. The Einstein-de Haas experience clearly shows how microscopic processes, studied only by quantum mechanics, manifest themselves in macroscopic processes. This situation radically changes the traditional notion of the relationship between the microscopic level described in terms of particles and the macroscopic level described in terms of concentrations, densities and volumes. A similar effect should also be observed when dipole vortices of dark energy hit the magnetic fields of galaxies. The resulting large domains have a sufficient mass for gravity and serve as structural elements that form a dark matter. In the intergalactic space, where there is no disturbing factor of masses and magnetic fields of large cosmic formations (galaxies) , there is no and dark matter. If RZG is equal to the radius of zero gravity, i.e. space, where the gravitational and repulsive forces are equal, then for R <RZG gravity prevails, with R> RZG - repulsion. The paper A. Chernin [3] 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} Mɵ. 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. [3]. 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 equal, i.e. the following relation will be fulfilled:

$$\rho\,(B,0) \sim \rho\,(DM,\,0) \qquad (3)$$

It is only about mean values. In fact, the particles of dark matter are not evenly distributed in the local group. Due to the fact that dark matter has gravitational properties, the density of its particles in the neighborhood of stars and planets will be higher. The presence of additional gravitating masses of dark matter in near-earth space was discovered during experiments with artificial satellites of the earth equipped with magnetometers. Inside the cylindrical capacitor, when it moves with respect to dark matter, a magnetic field arises, trapped by a sensitive magnetometer. With the help of magnetometers it was possible to detect in the near-Earth environment the moving vortex formations of dark matter - spinors. By the intensity of the magnetic field, the speed of motion of the satellite relative to dark matter was determined. It was found that the density of dark matter in the near-Earth environment depends on the gravitational field (potential V) in which the satellite is located. This was proved in experiments conducted in the Military Engineering Space Academy A.F.Mozhayskogo with clocks and magnetometers mounted on artificial satellites of the earth. The works were carried out in the 90s of the 20th century under the supervision of the deputy head of the academy for the scientific work of the professor, general V.F. Fateev. The results of the work were reported by Colonel V.L. Groshev on November 12, 1997 at a seminar in the Physical Society of St. Petersburg. It was found that toroidal luminous vortices with the size from microparticles to tens of meters are formed in areas of tectonic faults where intense electromagnetic and gravitational energy interaction is observed between the liquid earth magma and dark matter [10]. Evidence of the presence of dark matter in the near-Earth space was also the results of measuring cosmic rays in the near-Earth space by the detector AMC-02, placed on the ISS. Yu. Galaktionov, Massachusetts Institute of Technology (MIT), was able to detect the presence of an resonant maximum Fig.1 in the total spectrum of electrons and positrons at an external radiation energy Wp ≈15-20 GeV Fig.16,21,22[11].

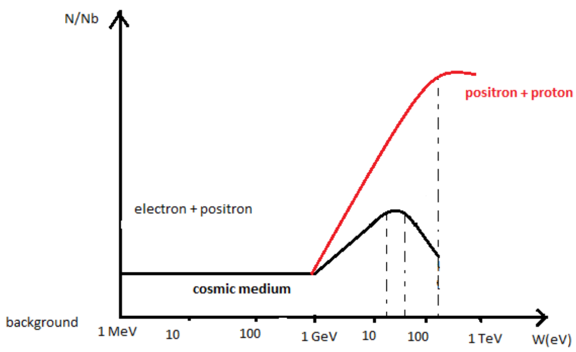

Figure1. *Graph of resonance curves of generation of secondary electrons and positrons*

This may indicate the generation of secondary electron-positron pairs in the near-Earth space environment of the dark matter. Analysis of the resonance curves shown in Fig.16 [11] allows to determine the photon frequency corresponding to the natural frequency of the structural element of the space medium (dark matter) and its wavelength. The frequency corresponding to the resonance energy of the photon (ν) and the natural frequency of the structural element of the dark matter is defined as the frequency of the Schrodinger and de Broglie wave functions (for resonance, they describe the same probability density):

$$\nu = W / h \text{ or } \quad \omega = W / \hbar \quad \text{and} \quad \lambda = 2\pi c / \omega \tag{4}$$

Where W - the photon energy

h - Planck constant $h = 6.6260 \cdot 10^{-34}$ J / Hz

$\hbar = h / (2\pi)$ $\hbar = 1{,}0546 \cdot 10^{-34}$ J / Hz

c - the speed of light c = 299792458 m / s

Thus, it is possible to determine the natural frequency of the structural element of the cosmic medium (physical vacuum) and wavelength:

$W_r \approx 20$ GeV $= 33 \cdot 10^{-10}$J, $\nu_r = 4.7 \cdot 10^{24}$ Hz, $\omega_r = 2.82 \cdot 10^{25}$ Hz, $\lambda_r = 6.39 \cdot 10^{-17}$ m

Professor A.V. Rykov, relying on his "Fundamentals of the theory of ether"[7], as early as 2000 obtained the value of the frequency of natural oscillations of the structural element of dark matter ν_r = 4.6911 • 10^{24} Hz. At the same time, he proposed to solve the problem of stability of the dipole structure of dark matter on the same principles of Pauli's quantum inhibitions as the stability of atomic structures of baryonic matter. Quantum prohibitions are associated with an integer number of De Broglie's waves, which must fit in the length of a stable orbit. The dipole is not destroyed due to the integer of wavelengths that are put into an orbital trajectory of dipole rotation. In his theory A. Rykov identified the frequency and wavelength for the dark matter dipole as follows:

$\nu d = 4.6911 \cdot 10^{24}$ Hz, $\lambda d = 6.3907 \cdot 10^{-17}$m

The length of a circular orbit for the dipole is

$$Ld = 2\pi r, \qquad Ld = 8.7890 \cdot 10^{-15} \text{ m} \tag{5}$$

where r is a size of a dipole structural element equal to a distance between virtual particles, i.e. electrons and positrons in the dipole $r = 1.3988 \cdot 10^{-15}$ m.

A ratio of the dipole orbit length Ld to the dipole own wavelength λd is equal to 137.5335. This approximate integer value of wavelengths' halves fits into the orbit length and is a quantum condition for stability in the dipole structure of the cosmic ether. Number 137.5335 agrees well with the experimentally obtained value for a magnitude of the fine structure $\alpha = 1/137.0355$ of elementary particles. This fact underlines a deep connection between a structure of the within the dark matter and a structure of elementary particles.

According to Rykov, with the size of the structural element of the cosmic medium dipole $r = 1.3988 \cdot 10^{-15}$ m, the ultimate deformation (destruction boundary) $dr = 1.0207 \cdot 10^{-17}$ m is related by the relation $dr = \alpha\ r$, where $\alpha = 0.0072975$ is the fine structure constant. Destruction boundary corresponds to the external photon energy W ≥ 1 MeV (the initial boundary of the photoelectric effect in the dark matter. The photon frequency $\nu_i = 2.4891 \cdot 10^{20}$ Hz). The deformation in physical vacuum is less than dr should be of an electro elastic character, and at higher values, deformation leads to the destruction of the dark matter dipole and to the creation of an electron-positron pair [7].

3. Conclusion

A simple minimal extension of the Standard Model (SM) called SMASH, proposed by Dr. G. Ballesteros of the University of Paris-Saclay France, is clearly not enough , as it is not capable of explaining the nature of dark energy [12]. In the framework of the new cosmological model presented in this paper, dark energy and dark matter have a quantum structure and are considered as a superfluid medium (the ^{3}He-B analog). The representation of dark energy and dark matter as two phases of non-baryonic matter makes it possible to answer the nature of dark energy and dark matter, the mystery of the accelerated expansion of the universe and the role of the cosmological constant in this process [4].

In turn, non-baryonic matter, which forms the basis of the intergalactic medium, is in constant force interaction with the baryonic substance of planets and stars that is born from it. The instability of the physical vacuum 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 matter) [13]. In the reverse process of annihilation of electron-positron pairs, a dipole of dark matter is formed. In this case, the charge is fully compensated, only the spin and mass of the pair remain and the pair becomes unobservable. The absence of a charge makes it all pervasive and the presence of such pairs can be determined only by their polarization in electric and magnetic fields. This allows us to consider a non-baryonic medium consisting of electron-positron dipoles, as a real candidate for intermediaries in the propagation with the speed of light of transverse electromagnetic waves and propagation with superluminal velocity of longitudinal gravitational waves. Such a quantum medium can have a density of energy (mass) equal to the density of baryonic matter and be a component of dark matter.

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