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Exhaustion of Polarization Light

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Abstract-The study of the vacuum polarization phenomenon and the nature of its quantum structure is an actual problem in modern physics. In quantum electrodynamics (QED), the instability of a physical vacuum is characterized by the formation of pairs of elementary particles. The article contains descriptions of experiments, that allow substantiate the quantum structure of vacuum and the reality of particles arising in a vacuum as a result of its polarization. The idea of "virtuality" of particles is connected with the inability of quantum field theory to describe the real mechanism of vacuum polarization.

IndexTerms-Vacuum, darkmatter, polarization, electron, positron, proton

1. THE MAIN TEXT

In classical electrodynamics, vacuum is a "medium" with absolute dielectric and magnetic permeability (ε_a, μ_a), which are equal to the dielectric and magnetic constant (ε_o, μ_o). The electric strength of the vacuum is infinite, that is, theoretically the electric field of any intensity cannot cause conduction currents in a vacuum due to the lack of charge carriers. In other words, the electric field strength **E**, the magnetic field strength H, as well as the density of electromagnetic energy in vacuum defined by them, can be infinitely large. It should be noted that these conclusions are obtained from the standpoint of the classical electrodynamics of Maxwell's linear field and, in the light of the latest achievements of quantum electrodynamics (QED), are incorrect. In QED, the instability of a physical vacuum under the influence of cosmic radiation, relativistic protons and electrons, peak electric fields, or high-intensity laser radiation is characterized by the avalanche formation of electron-positron pairs in a vacuum [1, 2, 3], to attain a tension of the order of Es for the field that generates electron-positron pairs.

($E_s = m^2/e = 1{,}32\cdot10^{16}$ $V\cdot cm^{-1}$ the characteristic quantum- electrodynamics Sauter's field) [3]. It should be noted that any quantum process of pair production from vacuum is accompanied by various many partial processes. In QED there is still no complete clarity on how to solve the problem of the production of pairs of elementary Particles and antiparticles in a vacuum under the action of external fields, relying on the corresponding the Klein-Gordon-Fock and Diract equations.

2. MAJOR HEADINGS

Polarization Of Vacuum And Transformation Of Vacuum Into Matter

In quantum theory, vacuum polarization is a collection of virtual processes of creation and annihilation of pairs of particles in a vacuum caused by quantum fluctuations. Nobel laureate R. Feynman presented such fluctuations geometrically in the form of diagrams [4]. Feynman constructed diagrams abstracting from real physical processes, so he pictured vacuum with a wavy line, and the virtual fluctuation that appeared in it is shown by a ring or a loop formed by symmetrical arrows (Fig. 1). However, the wave image implies that this wave moves, and on the diagram of this movement is not indicated, therefore the ring can arise only if it is formed from a point. Feynman, depicting such a fluctuation separately, depicted it in the form of a ring in which an electron and a positron move in one orbit, in one direction one after another, at diametrically opposite points of this ring. Considering the electron-positron pair, it is necessary to pay attention to the fact that in addition to the charge, each elementary particle has a spin, which indicates that the particle has a Rotation and has an axis of such rotation. The claimed zero parameters of the vacuum quantum are fully realized. Two opposite electric charges cancel each other, and both spins add up with the opposite sign and both rotations are also mutually compensated. With respect to mass compensation, the explanation is this: each of the pair particles is a quantum gyroscope, which means. That the axis of rotation of the particle is strictly defined in space and remains unchanged. In order for an electron and a positron to perform a joint gyroscopic rotation in a pair, the axes of their rotation must coincide.

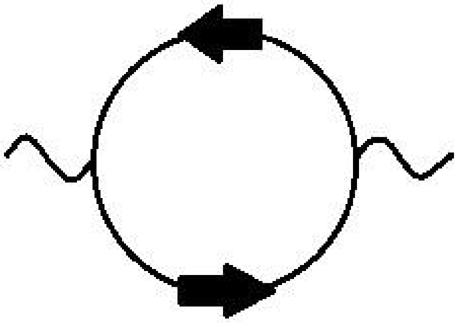


Figure1. The Feymann's of diagram. The electron-positron pair (virtual)

At the same time, the quantum vacuum is transformed into a quantum particle by the Heisenberg's relation. By virtue of the uncertainty principle in a vacuum, virtual particles can exist. In this case, even the creation of charged particles in pair with its antiparticle is possible. Such a production of a pair of particles on the Feynman's diagram is represented by a virtual ring. A virtual ring, supposedly, can exist for a very short time - within the quantum uncertainty $\delta t \sim \hbar / \delta E$, so as not to violate the law of conservation of energy.

In quantum electrodynamics, vacuum polarization consists in the formation of virtual electron- positron pairs under the influence of a quantum of the electromagnetic field of a photon or under the influence of a peak electric field. In the theory of gravitation, vacuum polarization is also present, and theoretically it is manifested at extremely small Planck distances ~ 10^{-35}m. It is assumed that the processes of gravitational polarization of vacuum play an important role in cosmology [5].

$w = w^p + w^e$ (1)

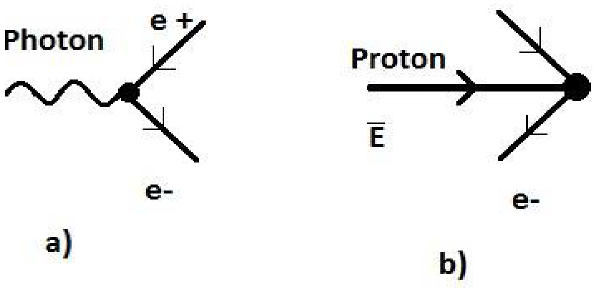
where w^p is the vacuum polarization, $w^p << E^2 / 8\pi$;

w^e is the change in the energy of the substance at the production of particles

2 2 2

$w^e = eET\varkappa$, $\varkappa = e E T \exp(-\pi m$ (2)

The creation of particles is the main reason for the change in the energy of the vacuum. The small value of the reverse reaction w^p implies the limitation on the electric field strength for a given time T ($E_s \approx 10^{16}$ V · cm^{-1} is the critical Schwinger's field) [1]. In studies conducted in 1996-99 on the SLAC linear accelerator, only a few electron-positron pair creation events were detected at a laser pulse intensity of 10^{17} W· cm^{-2}. This is very reminiscent of the extensive atmospheric showers generated by cosmic particles. They are called S-cascades [2,3]. In this comparison of space observations with the results of laboratory studies demonstrates deep analogies, evidencing, at a minimum, the unity of the physical principles of the behavior of matter in a wide range of densities and temperatures.vacuum in experiments in near-Earth space [6]. The very definition of dark matter falls under the description of the properties of vacuum in quantum electrodynamics - not to radiate and be invisible, to have mass and to possess a structure, to exhibit elastic properties in the propagation of electromagnetic waves. The quantum structure of the vacuum is due to particles in the low-energy state. The instability of a vacuum under the influence of cosmic radiation, relativistic protons and electrons or peak electric fields is a purely quantum phenomenon. In quantum electrodynamics this phenomenon is characterized by the formation of electron-positron pairs in a vacuum. The direction of motion of secondary electron- positron pairs produced in a vacuum (dark matter) can be determined by the nature of the effect that caused the polarization of the vacuum. Under the influence of rigid photons (bosons), the deformation of the vacuum occurs in the transverse direction to the propagation of the perturbation, which determines the direction of motion of electron-positron pairs (Fig.2a). This can be seen by analyzing the observation data on the fluxes of secondary electron- positron pairs with a soft energy spectrum in quantum-dynamic cascades in an intense laser field or in the near-Earth environment under the action of cosmic-ray photons in the PAMELA and AMS-02 experiments [7,8]. If vacuum polarization is caused by the motion of relativistic charges or by a peak electric field strictly oriented in one direction, then the secondary electron-positron pairs produced in vacuum will move in the direction opposite to the momentum of the primary charged particles, with zero transverse momentum $p^{\perp} = 0$, since deformation the vacuum will occur in the longitudinal direction (Fig.2b).



Vacuum

if vacuum polarization is caused by the motion of photon

if vacuum polarization is caused by the motion of relativistic proton or by a peak electric field strictly oriented in one direction E

An experimental confirmation of this could be the appearance of a flow of backward electrons with a "soft" energy spectrum in multiwave Cherenkov generators (MWCG). One of the peculiarities of the work of MWCG using an electron beam of microsecond duration with an initial charged-particle energy $W_e \sim 2$ MeV and a common current $I \sim 20$ kA is a relatively short radiation pulse in the three-centimeter wavelength range with a record power level of up to 15 GW [9]. The most recent information message on the comprehensive testing engine Em Drive "Measurement of Impulsive Thrust from a Closed Radio-Frequency Cavity in Vacuum» was published in Journal of Propulsion and Power in 2016 [10]. the quantum vacuum a dynamic mediumand could potentially be modeled at the microscopic level as an the electron-positron plasma. If the vacuum is indeed mutable and degradable as was explored, then it might be possible to do / extract work on / from the vacuum, and thereby be possible to push off of the quantum vacuum and preserve the laws of conservation of energy and conservation of momentum..." [10].

Experiments

Let us consider some effects due to the polarization of the vacuum, that is, having their roots in the structure of the vacuum (dark matter):

$Wht = h\,\nu$ = Wdef = e_0 Edr (3)

where h is the Planck constant

ν is the photon frequency e_0 is the dipole charge

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Analysis of the spectral curves of secondary electrons and positrons, presented in the work [8], makes it possible to determine the resonant energy of photons providing the maximum of pair production in a vacuum (dark matter).

$\nu = W / h$ or $\omega = W / \hbar$ and $\lambda = 2\pi c / \omega$ (4) $W_r \approx 20$ 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 [11].

Resonant maximum of the total energy spectrum of secondary electrons and positrons at the photon energy Wp ≈10-20 GeV (Fig. 16), as well as maxima of energy spectra obtained separately for positrons (Fig. 21) and electrons (Fig. 22) in experiments AMS-02 (2011-2015) convincingly confirm the quantum structure of the vacuum [8]. Direct experimental determination of the resonant dependence of the production of N pairs of elementary particles on the frequency ν is almost completely suppressed by modern physics. Following the deceptive logic of modern theory, this dependence is drawn in the form of a monotonically increasing curve. However, an analysis of the results of the AMS -02 experiment made it possible to establish that neither electronic nor positron spectra can be described by a power law with a single exponent in the entire energy range under study.

The Casimir's Effect

The effect of the interaction between two uncharged metal plates was predicted by the Dutch physicist Hendrik Casimir in 1948. The most accurate experimental measurement of the Casimir's force was made in 1998. Umar Mohideen and colleagues from the University of California at Riverside, in a series of experiments, brought a sphere covered with aluminum or gold to a distance of 0.1 microns from a flat disk covered with these materials. The result of the attraction between the sphere and the disk was manifested in the deviation of the laser beam. The deviation of the results from the theoretical prediction did not exceed 1%. The distance between the plates, on which the Casimir's force begins to manifest itself, is of the order of several micrometers. However, the force grows rapidly with decreasing distance. At distances of the order of 10 nm - hundreds of sizes of a typical atom - the pressure created by the Casimir's effect turns out to be comparable with the atmospheric one. The Casimir's force acting per unit area for two parallel ideal mirror surfaces in absolute vacuum is equal [12]

where ħ is the reduced Planck constant, $\hbar = h / (2\pi)$ $\hbar = 1{,}0546 \cdot 10^{-34}$ J / Hz

c is the speed of light in a vacuum. c = 299792458 m / s r is the distance between surfaces.

In quantum field theory this effect is explained using the concept of virtual particles. In the space between closely located mirror-polished surfaces, virtual photons are constantly born and disappear, along with virtual particles and antiparticles. Corresponding to all wavelengths of the electromagnetic spectrum. At certain resonant wavelengths (integer or semi-integer number of times stacked between the plate surfaces), electromagnetic waves amplify. All at all other wavelengths, the birth of virtual photons is suppressed. This is due to the fact that in the space between the plates only standing waves can exist, the amplitude of which on the plates is zero. As a result, the pressure of virtual photons on the inner surfaces of the plates is less than the pressure on the plates from the outside, where the production of photons is unlimited. The closer the plate surfaces to each other, the less between them is the virtual photon in resonance and the stronger the force of attraction between the plates.

Contradictions, since the transfer of energy from "vacuum fluctuations" to parallel plates by pressure requires real particles with real energy characteristics. Despite the fact that in the formula for the Casimir's force (5) there is no fine structure constant α - the main characteristic of the electromagnetic interaction

- this effect, however, has an electromagnetic origin. As shown in the monographs [12], when the finite conductivity of the plates is taken into account, a dependence appears for α, and the standard expression for the force appears in the limiting case $\alpha >> mc/4\pi\hbar nr^4$, where n is the electron density in the plate. The closer the electrons of neighboring plates to each other, the greater the conductivity is created in a vacuum, which decreases with increasing distance between the plates. Thus, conduction electrons from the surface layers of mirror-polished plates excite near themselves the quanta of vacuum (dark matter) and as a result, closely located plates enter into electromagnetic interaction. Thus, conduction electrons from the surface layers of mirror-polished plates excite near themselves the quanta of vacuum (dark matter) and as a result, closely located plates enter into each other's electromagnetic interaction. The sign of

reveal in a vacuum the superconductivity effect (the Meissner's effect, the Josephson's effect, the interaction force of the plates Fc depends on the mutual direction of the electric dipole

moments of the conduction electrons belonging

to the two plates d1 and d2. For d1 ↑↓ d2, Fc is the attractive force, for d1 ↑↑ d2 Fc is the repulsive force (the last variant is unstable with respect to perturbing effects). This conclusion agrees with the experimental data. In the course of the experiments, it was found that both uncharged parallel metal plates [12, 13] are attracted so, under certain conditions, and repulsion [14]. The last effect is called "Casimir-Livshits effect". In the framework of the electromagnetic model of vacuum (dark matter), as a quantum structure, it can be regarded as an analogue of superfluid medium

^{3}He-B [11]. First of all, it should be noted that the experimentally installed electric polarization of the medium in the core of the vortex in superfluid ^{3}He-B is due to deformation of the atoms ^{3}He consisting of electrically oppositely charged electrons and protons. A similar mechanism of electric dipole moment of the exist in the vacuum (dark matter), the microscopic structure of which are electrically oppositely charged electrons and positrons , forming a dipole. The relative motion of the particles that make up a Cooper pair in superfluid ^{3}He-B corresponds to the p-state. In this state between the electrically like charged particles of with spins oriented in the same direction, there are forces of attraction, and the electrically oppositely charged particles with spins oriented in the same direction of the force of repulsion. The result of these forces is the appearance of an electric

dipole moment. The interaction of vacuum

quanta due to the presence of electric dipole moments affects the viscosity of the medium and under certain conditions makes it possible to the London's effect). Since the conduction electrons of the plate are electrically charged, their electric fields act on the electric dipoles, which they create as a force moment, and the electric polarization of the vacuum arises in the space between the plates. This means that the pairs of micro particles constituting the quantum vacuum "stretch" along the electric field. For two parallel metal plates, the electric force due to the existence of the electric polarization of the vacuum (the formation of electric dipole moments around the conduction electrons of the plates) is defined as the Casimir force and can be expressed by the relation [15]:

$$F_c = F_d = {3d1d}/{r2} \quad \text{-----(6)}$$

where d1 and d2 is are, respectively, the total electric dipole moments of the conduction electrons (dipole moment e is $d_e = eL = e\hbar/p$) of the first and second plates (d1 ↑↓ d2 or d1 ↑↑ d2);

r is the distance between the plates , r ⊥ d1 (d2). In the experiments, value $r \approx 10^{9}$ m.

If the plates are identical, then d1 = d2. Let us find the expression for d1 (d2)

where N_0 is the concentration of conduction electrons in the metal. $N_0 \approx 10^{22}$;

ζ is the thickness of the surface layer of the plate, equal to the atomic size. $\zeta \approx 10^{-10}$ m;

μ_β is the Bohr magneton. $\mu_\beta = e\hbar / (2m_e c)$;

U_r is the energy of conduction electrons in metals. U_r is equal to the Fermi energy - ε_r

$\varepsilon_r = \hbar^2(3\pi^2 N_0)^{2/3} /(2m_e)$;

p is the amount of motion of the conduction electron in the metal. $p = 2m_e \varepsilon_r$

Substituting the expression for the electric dipole moment d1 (d2) into formula (6), we have:

$Fc=Fd=r^4 c^2 m, N_0 2$------(7)

The Meissner's Effect

The Meissner effect is that the superconductor pushes out the magnetic flux, that is: rot **B**=0. For the first time the nature of the Meissner effect was explained by F.London , who installed the connection between the current and the magnetic field in the superconductor. F.London formulated the equation [20]:

$4\pi\lambda^2$ rot **J** + **B** = 0 (11)
c

where **J** is the current density;

B is magnetic induction;

λ is penetration depth of magnetic field, $\lambda^2=mc^2/(4\pi nq^2)$

3. CONCLUSION

In conclusion, it should be noted that the world of virtual particles, which operate in modern quantum field theory, survives the last days. With the accumulation of knowledge about the microcosm, virtual particles give way to real particles. This can be confirmed by the experiments cited in this article, which say that when a vacuum enters a strong external field, the vacuum quanta are restructured and the real pairs of elementary particles are generated (vacuum polarization). The concept of "Vacuum" in the sense of empty space in the twentieth century was transformed into the concept of "Physical vacuum", filled with virtual particles that appeared for a brief moment as a result of vacuum fluctuations, and in the XXI st century it was supplemented by non-baryonic dark matter of the galactic medium and dark energy of the intergalactic medium. However, the short- term existence of virtual particles (not violating the energy conservation law) within the quantum uncertainty $\delta t \sim \hbar / \delta E$, includes the description of the virtual event by real quantities-time, Planck's constant and energy. In this connection, the question arises as to how this real description becomes virtual. Modern quantum field theory is not ready to describe nonlinear processes of production of real particles in a vacuum under the influence of external fields. In quantum electrodynamics, the electro magnetic field is quantized in the same way as the harmonic oscillator in quantum mechanics. For some of these fields, it is possible to construct the corresponding quantum theory of the Dirac field, but on the whole there are insurmountable difficulties connected with the creation of electron-positron pairs from the vacuum leading to nonlinear many-particle problems.

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