INTERESTING PROBLEMS OF THE INHOMOGENEOUS PHYSICAL VACUUM*

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Abstract: The void of space is examined to explain astrophysics problems. An attempt to model the vacuum was initially performed by Shipov and Akimov. They did not treat the vacuum, however, as a polarized medium but the void was a homogeneous entity akin to the zero-point field ideas known in the west. This was unsuccessful and the theory was extended by Dyatlov based upon data furnished by Dmitriev. The Dyatlov approach extends the Maxwell and Heaviside equations by treating the vacuum using classical polarization. The void consists of dipoles and moments that create electric, magnetic, gravitic, and spin fields; these dipoles are not elementary particles. The extended inhomogeneous theory provides insights into anomalous events on a global and smaller scale to treat ball lightning and unusual weather or natural events.

Introduction

One of the more recent concerns of contemporary scientists and engineers is to better understand the void of space and how to exploit the vacuum as an energy source to help man explore his galactic surroundings. This area is no longer considered as an empty wasteland of nothingness but holds future promise. The problem of the void, or as we will define as the vacuum, is similar phenomenon that exists in space may also exist elsewhere. Based upon preliminary investigations of anomalous phenomena in the earth's atmosphere,

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* "Views expressed in this article are those of the author and do not reflect the official policy or position of the U.S. Government."

we may fulfill a need to create a better understanding of the environment that may exist in space.

Shipov [1] examined problems in several astronomical investigations. He examined these problems by using the idea of geometrization of the equations of physics as a means of obtaining unification. This concept requires introducing several new fields to include the field of inertia and torsion fields. In contrast to Einstein, he places emphasis on the elementary particles and not on 'galaxies'. From these equations, Shipov is able to derive the equations of electrodynamics, gravity theory, the theory of nuclear force, and quantum mechanics. He does not, however, view the vacuum as a polarized medium but as a homogeneous entity. His theory is unable, however, to explain anomalous phenomenon. Akimov discusses the polarized vacuum states but not the concept of classical polarization of the vacuum. This state of affairs regarding understanding the physical vacuum requires further extensions.

All theories regarding vacuums usually ignore the concept of classical polarization. Although most contemporary scientists do not grasp its meaning, it appears that they were well understood by Lorentz, Polivanov, and Maxwell. In contemporary physics, the main stress is, however, on elementary particles and not dipoles. An initial assumption that dipoles are not elementary particles is absolutely foreign to contemporary physics.

The model that will be presented is a macroscopic representation. The contours of this model are constructed based upon the integral theory of classical polarizations. This is required to investigate anomalous phenomena, which exhibits a polarized nature. Moreover, the model differs decidedly from other physical models because it considers the physical vacuum of both matter and anti-matter. The model does not contradict any known physical phenomenon in the absolute physical vacuum sense nor does it introduce any new microscopic notions into the absolute physical vacuum. Maxwell's equations, for example, agree with all laws of physics. It introduces vacuum conditions. Nevertheless, these equations only treat the absolute physical vacuum, not more. If the vacuum requires a correction, so do these equations that describes this model. Finally, there is a need for experimental confirmation of any theory. In this case, more can be learned about the physical vacuum by using electric and magnetic traps in such places as in the abysses of the earth's fractures or in space. These ideas are briefly discussed in a companion paper.

Discussion

Problems in the inhomogeneous physical vacuum are connected with the unusual properties of anomalous phenomena as shown in figure 1 from

Dmitriev [2]. Our concern is to examine a subset of this phenomenon that includes ball lightning (BL) and naturally occurring tornadoes. In spite of the accidental character of ball lightning and a tornado's appearance, we can obtain a better defined physical portrait of these anomalous phenomena, for example, by A. Dmitriev [2]. Self-luminous bodies are observed in both of these events: in BL – which is in the form of a ball; in a tornado – in the form of an elongated taper. On closer analysis of the technical literature, we note that the self-luminous bodies of BL and tornados radiate not only at the frequency of light but also as electromagnetic waves in a considerably wider wavelength spectrum. Moreover, there are subsequent changes within the earth's electrical and magnetic fields in the immediate vicinity of self-luminous bodies.

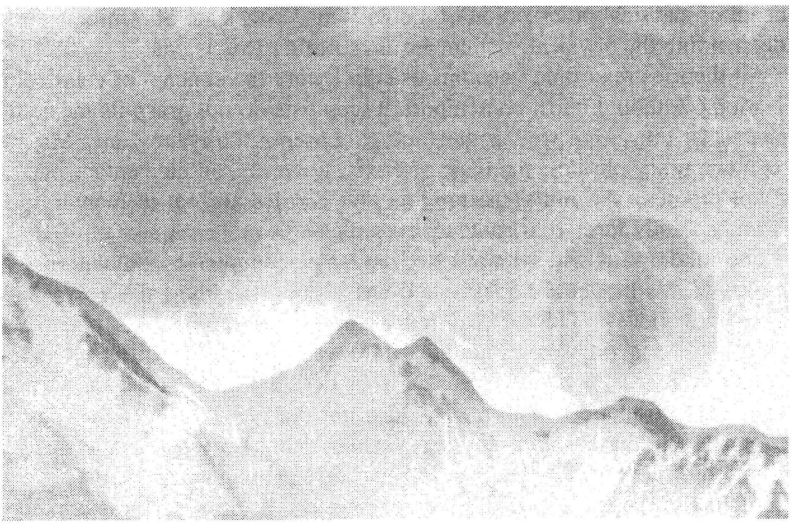

Fig.1. Largescale NSLF above the Katun's mountain ridge. The image was made aboard a helicopter on Aug.19, 1972 at 11:40 of local time. The observers' attention was drawn by "whitish shining spots in the direction of mt. Belukha summits". The disk and oval shapes, so distinctly visible on the photo, were not observed visually. An estimate of the objects using topographic charts of the region, gives more than 1.5 km in diameter. (photo of A.V. Semeshin, Camera "Kiev", exposure 1/250 s.)

The affinity of BL and the tornado phenomena involves an intensive rotation of gas that occurs not only within the self-luminous body of a tornado but also in a similar body such as BL. For BL, it is similar to the same characteristics as weak explosions, but has the form of a self-luminous body having an intermittent change of its flight dynamic trajectory. At the same time, intermittent motion is also characteristic for a tornado column. When such a moving column periodically touches the earth, tornadoes are seen to usually move along a "dotted line" where it touches the ground and then lifts up only to repeat this cycle. The "genetic" connection is real between BL and a tornado and is further emphasized by a tornado that has an accompaniment of a "bevy of BL". Additionally, there is data that supports the conclusion that BL and tornado occurrences usually increase during the active years of the sun spot cycles.

There is a large distinction in the sizes of self-luminous bodies such as tornadoes or BL. The large size of the tornado column allows one to notice a physical change in the gravitational field – levitation. A column of a tornado carries away large amounts of loose materials without scattering them as noted by V. Merkulov [3]. Such properties may take place due to a dipole distortion in the gravitational field within the tornado's column. By contrast, it is difficult to notice the property of levitation in BL due to their relatively small sizes (20–30 cm in diameter). This property is seen by implication, that dust and even small items may be captured inside the self-luminous body of BL.

In the context of contemporary wisdom, it is quite difficult, if not impossible to visualize some physical object with a set of physical properties comparable to either BL or a tornado. Within the confines of modern gravitational theories (Einstein and Heaviside), we are not able to obtain a local distortion of the earth's gravitational field. The electrical field and especially magnetic field emerge as though they are from a void. While we know that to artificially create these fields, one requires cumbersome electric and mechanical devices. It is also impossible to imagine that the self-luminescence of BL, for example, is caused by the existence of substantial plasma. Moreover, in the vacuum of the cosmos, in the earth's atmosphere, and even in water and in solid bodies, BL and similar objects are observed [2]. An intensive rotation of gas within the column of a tornado occurs when the tornado touches the ground due to the existence inside the tornado of a distributed moment of momentum of considerable magnitude [3]. Within the conventional wisdom, however, we are unable to suggest the nature or phenomenon that causes such a moment.

More than 100 physical models representing BL are available. All of them are created through the process of elimination of an "undesirable" part of the known properties of natural ball lightning. The same may also be said about known theoretical models regarding a tornado. Thus, ball lightning and tornadoes as well as other anomalous phenomena [2] are real scientific enigmas of our own era.

Unsuccessful attempts to find an explanation for these anomalous phenomena are based upon the modern physical theories of matter that leads us to the physical vacuum theories of Akimov and Shipov [1,3]. These vacuum theories are still under development but they contain very deep and interesting ideas.

A polarization model of the inhomogeneous physical vacuum is presented by Dyatlov [5] where the above theories of physical vacuum (vacuum as a polarized medium [4]) are discussed. In addition, new physical requirements due to the physical properties of BL and tornadoes are also used to substantiate these concepts. These requirements are as follows:

1. The model is constructed on the basis of unifying electrodynamics and gravidynamics, which are understood as material-vacuum polarization theories;
2. The model contains a physical description of a self-luminous body such as ball lightning, tornadoes and other anomalous phenomenon which is understood as some existing formation of a polarized vacuum; and
3. The model does not collide with commonly accepted physical notions of space and time outside of the self-luminous body.

In the present work we briefly consider a polarization model of an inhomogeneous vacuum and show the problems and potential solutions that develop in connection with several applications of this model.

In this presentation, the term polarization is used in the classical sense and represents a vector sum of elementary dipoles (not particles) and moments (which is understood as vectors) in the unit volume of a substance or vacuum. These items would otherwise be considered as vector densities of elementary dipoles or moments.

1. Physical Vacuum as a Polarized Medium: Maxwel's Equations

Maxwel's equations describe a physical vacuum as a polarized electr o-magnetic medium. These equations have the following form:

$$
\begin{aligned}
&\operatorname{div} \mathbf{D} = \rho;\\
&\nu_0 \operatorname{rot} \mathbf{E} = -\frac{\partial \mathbf{B}'}{\partial t};\\
&\operatorname{div} \mathbf{B}' = 0;\\
&\nu_0 \operatorname{rot} \mathbf{H}' = \mathbf{J} + \frac{\partial \mathbf{D}}{\partial t},
\end{aligned}
\qquad (1)
$$

where $\mathbf{E}$ and $\mathbf{H}' \equiv \mu_0 \mathbf{H}$ are electrical and magnetic fields respectively; $\mu_0 = 1.257 \cdot 10^{-6}$ m · kg · s^{-2} A^{-2}; $\mathbf{H}$ is the magnetic field; $\mathbf{D}$ and $\mathbf{B}' \equiv \mathbf{B}/\mu_0$ are electrical and magnetic inductions;

$$
\left.
\begin{aligned}
\mathbf{D} &= \mathbf{P}_{OE} + \mathbf{P}\\
\mathbf{B}' &= \mathbf{P}_{0\mathbf{M}} + \mathbf{M}
\end{aligned}
\right\}. \qquad (2)
$$

$\mathbf{B}$ is the induction which is known in Maxwell's equations; ρ, $\mathbf{J}$ are densities of electrical charges and currents; $\mathbf{P}$, $\mathbf{M}$ are electrical and magnetic polarizations of the material (they are defined as the vector densities of electrical dipoles and magnetic moments) respectively; $\mathbf{P}_{0E}$, $\mathbf{P}_{0M}$ are the electrical and magnetic polarizations of the physical vacuum correspondingly; $\nu_0 = 1/\mu_0 = 0.796 \cdot 10^6$ $m^{-1}kg^{-1}s^2A^2$.

From (2) it follows that inductions are the sums of polarizations of the physical vacuum and material, hence they are also polarized. The vectors $\mathbf{E}$, $\mathbf{H}'$ remain as fields. Thus the vectors $\mathbf{D}, \mathbf{B}'$ and $\mathbf{E}, \mathbf{H}'$ have a completely different physical meaning. If one uses a mechanical analogy then the first equation appears to be analogous to generalized coordinates, the second equation to forces.

If we put $\mathbf{P}_{0E} = \varepsilon_0 \mathbf{E}$, where $\varepsilon_0 = 8.855 \cdot 10^{-12}$ $m^{-3}kg^{-1}s^4A^2$, and $\mathbf{P}_{0M} = \nu_0$ $\mathbf{H}'$ and further we turn to μ_0, $\mathbf{H}$, $\mathbf{B}$ in the equations (1,2) then we obtain a standard form of Maxwel's equations in the system of MKSA units.

The standard form of Maxwell's equations already reflects the physical vacuum as a polarized medium in spite of requiring $\mathbf{B} = \mu_0 \mathbf{H} + \mu_0 \mathbf{M}$ that provides the true physical essence of these equations.

2. Physical Vacuum as a Polarized Gravispin Medium: Heaviside's Equations

The equations of Heaviside describe the physical vacuum as a gravispin-polarized medium by the following equations:

$$
\begin{aligned}
&\operatorname{div} \mathbf{D}_G = -\rho_G;\\
&v_{0S} \operatorname{rot} \mathbf{E}_G = -\frac{\partial \mathbf{B}'_S}{\partial t};\\
&\operatorname{div} \mathbf{B}'_S = 0;\\
&v_{0S} \operatorname{rot} \mathbf{H}'_S = -\mathbf{J}_G + \frac{\partial \mathbf{D}_G}{\partial t}.
\end{aligned}
\tag{3}
$$

$\mathbf{E}_G, \mathbf{H}'_S$ are gravitation and spin fields respectively; $\mathbf{D}_G, \mathbf{B}'_S$ are gravitational and spin inductions; ρ_G, $\mathbf{J}_G$ are the densities of masses and gravitational currents;

$$
\left.
\begin{aligned}
\mathbf{D}_G &= \mathbf{P}_{OG} + \mathbf{P}_G;\\
\mathbf{B}'_S &= \mathbf{P}_{OS} + \mathbf{P}_S,
\end{aligned}
\right\}
\tag{4}
$$

and $\mathbf{P}_G$, $\mathbf{P}_S$ are respectively the gravitation and spin polarization of the physical vacuum; $v_{0S} = c^2/ 4\,\pi G = 1.0649 \cdot 10^{26}$ m^{-1} kg; $G = 6.672 \cdot 10^{-11}$ m^{3}kg^{-1}s^{-2} are the gravitational constants; c = $2.998 \cdot 10^8$ m s^{-1} is the speed of light (the speed of gravitational waves is assumed to be equal to the speed of light in this analysis).

According to (4), the Heaviside's equations, as well as Maxwell's equations, treat the inductions as the sums of polarizations. Thus in the case of gravidynamics, the inductions also have the physical property of polarization.

In Dyatlov [5], the polarizations of material P_G and P_S are negligibly small. If we put $\mathbf{P}_{0G} = \varepsilon_{0G} \mathbf{E}_G$, where $\varepsilon_{0G} = 1/ 4\pi G = 1.193 \cdot 10^9$ m^{-3}kg s^2 and $\mathbf{P}_{0S} = v_S \mathbf{H}'_S$, then for the Heaviside equations we may obtain a form that is well known in the literature [6,7].

3. Absolute Physical Vacuum

In both Maxwell's equations (1, 2) and in the Heaviside equations (3, 4), the vacuum polarizations $\mathbf{P}_{0E}$, $\mathbf{P}_{0M}$, $\mathbf{P}_{0G}$ and $\mathbf{P}_{0S}$ characterize the physical vacuum as a polarized medium. In the same equations the different kinds of material characterize the densities of charges ρ, ρ_G, currents $\mathbf{J}$, $\mathbf{J}_G$ and four substantial polarizations $\mathbf{P}$, $\mathbf{M}$, $\mathbf{P}_G$, $\mathbf{P}_S$. The absence of material (substance) sets the equality to zero for all substantial charges, currents, and polarizations. In this case the equations of Maxwell and hence those of Heaviside are called "vacuum equations".

The form of the equations (1–4) allows one to consider the different polarized vacuums. Let us allow:

$$\left.\begin{aligned} \mathbf{P}_{0E} &= \varepsilon_0 \mathbf{E}; \\ \mathbf{P}_{0M} &= \nu_0 \mathbf{H}'; \\ \mathbf{P}_{0G} &= \varepsilon_{0G} \mathbf{E}'_G; \\ \mathbf{P}_{0S} &= \nu_{0S} \mathbf{H}'_S, \end{aligned}\right\} \tag{5}$$

We obtain the physical vacuum that for a long time was called and understood as "a void". This vacuum, according to Shipov [1], we shall call the absolute physical vacuum (APV).

Two vacuum polarized mediums are consisted in APV: electromagnetic and the other is gravispin. Such mediums may be conceived if we assume that elementary particles of physical vacuum – fitons [4] falls within Dyatlov's quadrigues of particle [1, 8]. This quadrigue is shown in fig.2,

1 +m, +q, +s, +μ	2 +m, –q, +s, –μ
3 –m, –q, –s, –μ	4 –m, +q, –s, +μ

Fig.2. Dyatlov's quadrigue of particles

where m – mass; q – electrical charge; s – spin; μ – magnetic moment.

The fiton in the form of the Dyatlov's quadrigue makes the APV "globally" neutral [1] and it easily explains why in APV electromagnetic and gravispin physical properties appear to be absolutely unrelated. From fig.1. It is seen that Dyatlov's quadrigue is defined for the fiton as some peculiar quadripole where a pushing apart, for example, of positive and negative masses leads to the creation of a gravitational dipole but doesn't lead to the creation of other dipoles and so on.

The equations (1, 2) of Maxwell and (3, 4) of Heaviside for the APV are Lorentz –covariant and are compatible with the equations of Minkovski mechanics [9] with the special theory of relativity.

4. Physical vacuums of matter and antimatter

A great number of physical phenomenons can be explained by the conventional wisdom based upon the assumption that there is no connection between electrodynamics and the theory of gravity. This assumption using classical electrodynamics and in the wake of quantum electrodynamics, allows us with a split-hair accuracy, to describe electromagnetic physical phenomena. Such facts obviously correspond to situations when a vacuum medium represents an APV. However, certain successes in modern physics keep us from advocating that all space within the Universe is filled with APV, whereas a large number of inexplicable anomalous phenomena exist. One possibility is to explain such phenomena in connection with a search for physical vacuums other than APV. In the above, we have already prepared the equations of Maxwell and Heaviside to define such vacuums.

For vacuums that are different from the APV, we will start from a principle of Shipov that implies the global neutrality of the physical vacuum [1]. According to Shipov, the sums of electrical charges, magnetic moments, masses and spins in every physical point of the unexcited vacuum (under condition that fields are equal to zero) is equal to zero. According to this principle, due to Dyatlov's quadrigue one may see that beside APV, two more physical vacuums can exist which are shown together with APV in Fig.3.

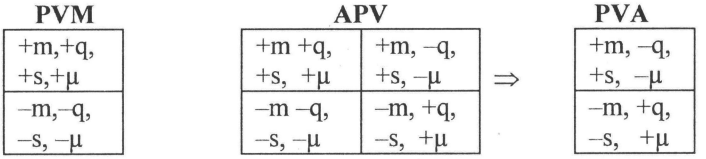

Fig.3. The division of Dyatlov's quadrigue into two dyads PVM and PVA.

The first of these vacuums we call a physical vacuum of matter (PVM), whereas a particle +m, +q, +s, +μ enters into it's dyad. The second vacuum is called a physical vacuum of antimatter (PVA), whereas an antiparticle +m, −q, +s, −μ enters in it's dyad (matter possesses a positive mass. Thus, particles and antiparticles belong to matter; material is everything: matter, negative mass, and fields).

It is seen from fig.3 that PVM and PVA create bound dipoles and moments. Electrical and gravitational dipoles, magnetic and spin moments coincide in the direction in PVM. In PVA electrical and gravitational dipoles, magnetic and spin moments are just the opposite.

An electrogravitational and magnetospin connection exists in PVM and PVA and this may be expressed mathematically as follows:

$$\left.\begin{aligned} \mathbf{P}_{0E} &= \varepsilon\varepsilon_0\mathbf{E} \pm \varepsilon_1\mathbf{E}_G; \\ \mathbf{P}_{0M} &= \nu\nu_0\mathbf{H}' \pm \nu_1\mathbf{H}'_S; \\ \mathbf{P}_{0G} &= \varepsilon_G\varepsilon_{0G}\mathbf{E}'_G \pm \varepsilon_1\mathbf{E}; \\ \mathbf{P}_{0S} &= \nu_S\nu_{0S}\mathbf{H}'_S \pm \nu_1\mathbf{H}', \end{aligned}\right\} \qquad (6)$$

where: $\varepsilon, \nu \equiv \mu, \varepsilon_G, \nu_G$ are relative electrical, magnetic, gravitational and spin permeability of PVM and PVA material; ε_1, ν_1 are coefficients of an electrogravitational and magnetospin bound media; a "+" sign relates to PVM; a "–" sign relates to PVA.

It is obvious that the expressions for the vacuum polarizations (6) at $\varepsilon_1 \neq 1$ and $\nu_1 \neq 0$ link the equations of both Maxwell (1,2) and Heaviside (3,4) in a system of linear differential quadratic equations. In this algebraic system, parameters such as $\varepsilon_0, \nu_0, \varepsilon_{0G}, \nu_{0S}$ have certain numerical values, and the parameters ε_1 ; ν_1 ; ε ; ν; ε_G; ν_S are free in the sense that their values are determined based upon the physical properties of observable anomalous phenomena [5], it is accepted that $\varepsilon = 1$; $\nu = 1$; $\varepsilon_G = 1$; $\nu_S = 1$;

$$\alpha_\varepsilon = \varepsilon_1 / \sqrt{\varepsilon_0\varepsilon_{0G}}\,; \quad \alpha_\nu = \alpha_\mu = \nu_1 / \sqrt{\nu_0\nu_{0S}} = \mu_1 / \sqrt{\mu_0\mu_{oG}}\,.$$

Thus we believe that physical properties of PVM and PVA matter are reflected within the equations (1–4, 6), which may be called the equations of combined *electrogravidynamics*.

5. Polarization Model for an Inhomogeneous Vacuum: Vacuum domains

The space regions of self-luminous bodies such as ball lightning, tornadoes and other anomalous phenomena are filled with PVM and PVA or with mixtures of PVM and APV, PVA and APV. We shall describe the different mixtures with equations (1–4, 6) by decreasing numerical values of the coefficients of the electrogravitational connection coefficient ε_1 and the magnetospin connection coefficient ν_1. The space regions outside of the self-luminous bodies are assumed to be filled with APV.

Thus, there arises a polarization model for the inhomogeneous physical vacuum [5], where a description of physical properties of anomalous phenomena is revealed as a solution to the boundary-value problems of mathematical

physics. In these problems we always assume that there is some body having a definite form and size. A medium inside the body is described by the equations (1–4, 6), whereas the medium outside this body – with equations (1–4, 5). We formulate boundary conditions similar to the boundary conditions in an analogous problem of electrodynamics. Assuming that the surface currents and charges are absent at the boundary of a body from the equations (1–4) themselves, it is necessary to set normal projections of inductions and tangential projections of the field to be equal inside and outside the body along the boundary surface.

In this theory, we need to give to the body under investigation a designator other than an abstract name such as "self -luminous body". Since the model of the inhomogeneous vacuum shows a possibility for vacuum objects having all the properties of BL and tornadoes, to exist without being clearly defined as "self-luminous". Here, "self-luminous bodies" will be called vacuum domains as in [5].

The physical concept of a vacuum domain is developed from the Big Bang theory by Zeldovich and Kozyrev [10]. This concept, however, only relates to the forces within the nucleus and not to macroscopic electromagnetic and gravitational fields. At the same time, a term within the definition of the vacuum domain is also appropriate in the model on the basis of classical polarization theory.

A remarkable peculiarity of these problems of combined electrogravidynamics is that they allow one to obtain solutions that resemble simultaneously passing through a large number of physical processes (about 10). Such steps are exactly what occur within the BL and tornado phenomena. However, all these processes develop as an inverse problem when external fields are defined. If we set all sources of fields (charges, masses, and currents) equal to zero, then we obtain a homogeneous system of equations that give solutions at the external fields that are equal to zero. In all these problems using this model, the vacuum domain plays a role as a transformer that converts the electromagnetic field energy into the energy of the gravispin fields and vice versa as well as into mechanical and thermal energy.

6. The Initiation and Disappearance of Vacuum Domains in the Universe

The initial appearance and disappearance of vacuum domains within the Universe should be considered as the physical essence of a vacuum, which is understood as a medium occupied with elementary particles. Such concepts already have a long history for their development dating back to the electron-positron vacuum of Dirac. Later in the quantum field theory a physical vac-

uum arises, which is understood to be analogous to a "boiling bouillon from which virtual particles-antiparticles" [1] appear and disappear. Furthermore, one may think of the physical vacuum as some type of "crystal lattice" formed by particles-antiparticles (quarks, gluons) as suggested by Simonov and Shevchenko [11].

It should be noted, however, that the progress of the idea that a "vacuum is not a void" goes against the notion of an old problem from gravitational theory – that is: the problem of the gravity paradox. When elementary particles occupy a vacuum, the vacuum acquires a positive mass, whereas at present the majority of physicists say no to the logic of using negative mass [12]. Thus, vacuums should increase in positive mass if we do not consider particles having negative mass.

Without question, the acceptance of negative mass equal to positive mass in the Universe [4, 8] leads to the fact that the law of the increase in entropy is somehow affected. But it is only touched, whereas the problem of the gravity paradox is completely eliminated. One may construct theoretical models where physical processes are connected with an increase in entropy that passes into local regions and physical processes connected with a decrease in entropy, that are strongly scattered in the space of the Universe. Hence the law for the growth in entropy is still satisfied in every local physical process but as a whole within the Universe, entropy remains constant. Thus, one more unpleasant problem of physics – the problem of a thermal dearth of the Universe is thus easily eliminated. The polarization model of the inhomogeneous vacuum [5] considered in the present work relates to similar models.

The negative mass particles of Ya. Terletskiy and G. Shipov allows one to take a new look at the old ideas that the "vacuum is a polarized medium". It is possible to introduce to the vacuum not only electrical and magnetic but also gravitational dipoles and moments. Such a vacuum is naturally described with the vacuum by Maxwel's and Heaviside's equations instead of Einstein's ge n-eral theory of the relativity (GTR).

Eliminating the GTR from consideration is a hard step, but yet it is possible due to the weak experimental basis of GTR shown by many famous physicists of which the first was Brillouin [13].

Evolving from the idea that the "vacuum is a polarized medium" on the basis of the Dyatlov quadrigue of particles, we come to the conclusion that three physical vacuums can exist: APV, PVM and PVA. Here, PVM and PVA are fragments of APV as clearly seen from fig.3. Thus, a modified vacuum of the vacuum domains is formed from fragments of the main physical vacuum of the Universe – APV. Naturally some questions arise. Under what

effect does the energy of the APV split into PVM and PVA; how does elementary particles of PVM and PVA gather for macroscopic formations – vacuum domains? What happens with vacuum domains inside the Earth, where we are still not able to observe them?

In regard to the first question, we shall recall that the occurrence of a number of observable BL and tornado events increases by several times occurs during the active years of the sun cycle [2]. Another phenomena is similar to BL and tornadoes, that of so-called plasmoids. These phenomena possess almost all the same physical properties of BL and a tornado. However, direct observations associated with plasmoids suggest they appear in the form of a "strong magnetized plasma" in the vicinity of the earth, they are seen as a every strong flash on the sun's surface by Avakyan [14]. In this regard, we also note that vacuum domains possess properties that allow them to maintain plasma in rarefied gases. Furthermore, the appearance of plasma is but a secondary process [5].

Thus, we find a source for the appearance of vacuum domains on the Earth. This source is the Sun and other stars. However, we obtain an answer to only half of the previously mentioned questions. All other questions are beyond the scope of the macroscopic polarization model of the inhomogeneous physical vacuum and an answer is given only by the physics of high-energy elementary particles.

Based upon general considerations, we may assume that the vacuum domains of PVM and PVA during their formations, result from the reaction of splitting. This is due to the APV capturing part of the sun's and stars' energy and removing it to the open spaces. We yet do not have a relaxation time (a lifetime) for the vacuum domains of PVM and PVA. However, according to known observations of plasmoids, we may assume that this time is a large value for vacuum domains of PVM as well as for PVA. Furthermore, we may assume that vacuum domains of PVM and PVA occur on the surface of, and inside planets under different thermodynamic conditions than those on stars. These forms should annihilate to form an APV, releasing a part of the initially captured energy in the form of photons [5].

It is well known in geophysics that some zones of the Earth in the places of its Plutonic fractures or earth faults are zones of "power-overflow" [2,15]. Geologists do not indicate the type of energy that participates within the "power-overflow" but they do know of the energetic consequences of this process. This results in earthquakes (underground storms), volcanic eruptions, tornadoes, typhoons, and changes in the Earth's climate. All these geological-geophysical processes are connected measurably with the sun spot cycle.

On the other hand, the most frequent appearance of plasmoids, more correctly called natural self-luminous formations by A. Dmitriev [2], is in regions of Plutonic fractures of the Earth's crust. Thus, we have evidence that the main type of energy in the zones of "power-overflow" is energy from vacuum domains.

7. Problems of Formation of a Macroscopic Theory of Vacuum Domains

It is not difficult to see that the most observable physical processes in BL and tornadoes have a macroscopic nature. Methods of high-energy quantum physics cannot be used to describe these processes, which pass to low energy values of quantum transitions for elementary particles. The macroscopic scales of anomalous phenomena in the thermodynamic conditions on the Earth allows us to use the polarization model of the inhomogeneous vacuum, the macroscopic equations of Maxwell and Heaviside, and further include all those ideas from the classical theory of polarized mediums previously mentioned.

A description of physical properties of vacuum domains considering the polarization model of the inhomogeneous vacuum [5] allows one to answer almost all the questions connected with the observable properties of BL and tornadoes [3]. It also allows examining the physical properties of other geological-geophysical [2] and aerospace [14] anomalous phenomena (poltergeist or self-luminous emissions; plasmoids – UFOs; "angels", "cosmic ice"; ionospheric and atmospheric explosions; lithosphere explosion pipes; "sprites, elves, jets"; luminescence in earthquakes and volcanic eruptions and so on). The observable properties of geological–geophysical and aerospace anomalous phenomena include the following [2,5]: passage of self-luminous bodies through matter; self-luminescence, light absorption; additional electromagnetic radiation and absorption in a wide frequency spectrum; change in the dipole character of electrical, magnetic and gravitational (levitation – weight) Earth's fields; rotation of gas inside the self-luminous bodies; and explosions, in particular with preserving the form of a self-luminous body.

8. Additional Anomalous Events

At the same time the above types of anomalous phenomena and their properties do not exhaust all the different varieties of manifestations of the inhomogeneous vacuum's properties. A large group is also available that includes biological anomalous phenomena connected with the weak self-luminescence of biological objects (Kirlian effect), in particular, and the aura

of a human being. In the biological anomalous phenomena, we may see almost all of the same physical properties of geological – geophysical and aerospace anomalous phenomena in a strongly decayed form. Assuming that self-luminescence gives away the vacuum domain's presence in biological objects, we may apply the methods of the inhomogeneous physical vacuum to analyze biological anomalous phenomena [16].

A careful study of the numerous literature provides information that reflects upon the properties of anomalous phenomena, allows one to notice once more their physical property. For example, the changing mechanical characteristics of matter when immersed within self-luminous bodies. In a region of a tornado's action, wooden chips can pierce through steel plates [3]. In the active zone of a poltergeist (poltergeist is considered as an emission similar to a form of BL [5]), glass items scatter into dust with an explosive effect [17]. The polarization model of the inhomogeneous physical vacuum allows one to explain this mysterious property by considering that electrostatic and magnetic forces between atoms and molecules of the substance change in PVM or PVA [16]. Electrostatic forces should be multiplied by a coefficient $1/(1-\alpha_\varepsilon^2)$ and magnetic forces – by a coefficient $1/(1-\alpha^2_\nu)$, where $\alpha_\varepsilon = \varepsilon_1/\sqrt{\varepsilon_0\varepsilon_{0G}}$; $\alpha_\nu = \nu_1/\sqrt{\nu_0\nu_{0S}}$; $-1<\alpha_\varepsilon<1$; $-1<\alpha_\nu<1$.

Changing a substance's physical characteristics when it sinks into the PVM or PVA is due to the increase or decrease in the bound energy of solid matter. If this energy increases, then a modified vacuum may penetrate into matter only under the action of external forces. If this energy decreases, then the modified physical vacuum tends to penetrate into solid matter by replacing the APV.

Modifying mechanical characteristics of matter as it sinks into the physical vacuum allows one to understand many physical peculiarities of geological-geophysical, aerospace and, especially, biological anomalous phenomena. It is obvious that the physical properties of aggregate states of matter are fundamentally different for inorganic solids and for organic substances, especially for living organic substances. We suppose that the modified physical vacuum "sticks" to a living organic substance, forming, in particular, an aura of a human being, as we see it – a vacuum domain of a human being [16].

The bodies of UFO-plasmoids – natural self-luminous formations [2] may have a form, corresponding to various optical properties of light radiation, absorption, reflection and refraction. A "body" often reveals oneself only by its self-luminescence, but there are cases when a "body" has a black color that corresponds to strong light absorption. There are cases when a "body" has the

form of a metal-coated "object" which naturally reflects and diffracts light – this is the case when a UFO is mistaken for an "extraterrestrial plane".

We have a special interest, however, to the cases [2], when "a body" is not seen in the daytime and may only be seen at nighttime in the form of a human being's aura (only few individuals possess this property) or in the form of large flame columns (usually in abysmal places near the earth's fractures [2, 15]). These cases indicate that for a human being, without knowing it, may be in a space filled not only with APV but also with mixtures of APV with PVM or PVA as a weak concentration of the last two physical vacuums. By virtue of the previous discussion about a modification of substances in PVM and PVA, it is natural to conclude that the indicated mixtures will influence a human being not only through a weak "bulk" γ-radiation but also through a direct "mechanical" influence on the living structure of a human being. Thus, a global problem of a physical vacuum's quality in human beings arises within different habitants.

The model of the inhomogeneous physical vacuum reflects all cases of different optical properties of "bodies" of anomalous phenomena under a variety of values for the coefficients ε_1 and ν_1. In [5], it is shown that a group velocity of plane waves of several vacuum domains, located in the cosmos or Earth's atmosphere in PVM or PVA, is expressed as:

$$v = \frac{2c}{\sqrt{(1+\alpha_\varepsilon)(1+\alpha_\nu)} + \sqrt{(1-\alpha_\varepsilon)(1-\alpha_\nu)}}, \tag{7}$$

where: c is the speed of light.

The total period, namely the time for a full transformation of the energy of an electromagnetic wave converted into the energy of an gravispin wave and back, is expressed by the relationship:

$$\Delta x = \frac{\lambda}{\sqrt{(1+\alpha_\varepsilon)(1+\alpha_\nu)} - \sqrt{(1-\alpha_\varepsilon)(1-\alpha_\nu)}}, \tag{8}$$

where λ is the electromagnetic or gravispin wavelength in APV.

From (7) it is seen that at $\alpha_\varepsilon = \alpha_\nu$ for v = c, that is in this case " a body" of vacuum domain is invisible. Only self-luminescence gives away its presence.

From (8) it is seen that at $\alpha_\varepsilon = -\alpha_\nu$

$$|\Delta x| \to \infty,$$

that is in this case the transformation of the energy of a gravispin wave into the energy of an electromagnetic wave and back doesn't occur. The "body" of the vacuum domain has the form of a "metal-coated "object", whereas at $\alpha_\varepsilon = -\alpha_\nu$, a surface of the "body" reflects only electromagnetic waves.

The polarization model of the inhomogeneous physical vacuum describes well the qualitative physical properties of many anomalous phenomena identifying these properties with those properties of vacuum domains. The model under consideration is an improvement over all presently known models of anomalous phenomena considering the complexity that is involved in these physical processes. At present, the model of the inhomogeneous vacuum, however, does not have a basis for a quantitative description of the physical properties of anomalous phenomena. It is our wishes that because of this model, technological devices will be created that will capture the basic vacuum properties previously mentioned. Only after this, can we address an effective improvement within the theory of the inhomogeneous physical vacuum and about a possibility of its transformation within the macroscopic theory of vacuum domains.

Conclusions

Problems within the inhomogeneous physical vacuum are foremost the same problems within the development of the vacuum domain theory; the theory requires a solid experimental foundation. At present, we see three specific directions for the continued development of this work:

1. The development of the macroscopic theory of vacuum domains on the basis of Maxwel's electrodynamics, Heaviside's gravidynamics and the classical theory of polarized inhomogeneous mediums to describe the macroscopic processes of anomalous phenomena;
2. The development of the microscopic quantum theory of vacuum domains, on the basis of the theory of high energy elementary particles to describe the microscopic processes of birth and annihilation of vacuum domains;
3. The development of an experimental basis for a preliminary study on using vacuum domains considering macroscopic and microscopic theories.

The polarization model of the inhomogeneous vacuum appears to be an irradiation, in the sense that it gives at once a qualitative explanation for a whole spectrum of macroscopic properties of vacuum domains of anomalous phenomena. On the contrary, there is a coincidence of physical properties inherent only to objects of the classical theory of polarized inhomogeneous mediums, with the properties of vacuum domains of anomalous phenomena.

This gives the most striking evidence in favor of the concept that the physical vacuum is a polarized and simultaneously electrical, magnetic, gravitational and spin medium. The polarization model of the inhomogeneous vacuum may play an important role to understand the whole theory of vacuum domains. At the same time, the model in question remains only a model and not a macroscopic theory of vacuum domains, since it still does not have an experimental basis to define the quantitative properties of vacuum domains.

The microscopic theory of vacuum domains has not made its first steps. However, the polarization model of the inhomogeneous physical vacuum has already applied certain restrictions on a future microscopic theory. The Heaviside equations are similar to Maxwell's equations, when secondary quantized, they give the value of 1 to the spin of a graviton, which is also equal to the spin value for a photon. At the same time, it follows from the GTR of Einstein that a spin of a graviton should be equal to 2. Thus Heaviside gravidynamics, followed by the polarization model of the inhomogeneous physical vacuum, comes into conflict with Einstein's GTR. Only by experiment, however, can one solve the discrepancy on the value of spin for a graviton. As long as such experiments are not performed, we cannot consider Einstein's GTR to be the last word of truth.

A strange opinion exists amongst many physicists that have only a superficial knowledge about macroscopic theories and that work only with quantum theories. That is: all problems of physics must find an explanation within quantum mechanics. Meanwhile the analysis of great physical theories shows that objectives are being attained only after a reasonable combination of macroscopic and microscopic (quantum) approaches.

The procedure for the comparison of experimental and calculated data must be performed in the polarization model of the inhomogeneous physical vacuum in the same way as in electrodynamics. Here, the calculations of fields are performed after determining all of the sources of the fields and all constants of the mediums in some defined space. For example, sources and parameters of mediums may be defined as tensors, operators, non-linear relations and so on. In electrodynamics, however, there is a powerful experimental basis for defining these parameters and functions. In electrogravidynamics it will be necessary to compile an experimental basis for determining specific parameters such as the two free parameters α_{μ}, and α_{ε} introduced during the analysis as well as several functions. For this purpose, it is necessary to establish laboratory conditions for research in vacuum domains. Such places already exist such as the abysses aligned with the Earth's fractures or by using magnetic and electric traps to capture vacuum domains.

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